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Upper Waikato nutrient efficiency study

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UPPER WAIKATO NUTRIENT EFFICIENCY STUDY

Prepared by AGFIRST Waikato For

Environment Waikato REGIONAL COUNCIL

DairyNZ Profitability. Sustainability. Competitiveness.

Ballance agri-nutrients

Fonterra Dairy for life

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Executive Summary and Recommendations

Summary

- The case study analysis has indicated potential to reduce nitrogen leaching considerably to low levels (26 kg N/Ha/Yr) with varying impacts on profitability. In some cases, low leaching systems are more profitable than the base line.
- Across the whole sample group, there was a lowering of total milk output of -9.5%, but an increase in per cow output of +8%.
- Different systems react differently to mitigation tools in terms of both profitability and reduction in nitrogen leaching.
- There does not appear to be any one 'recipe' which reduces nitrogen leaching and optimises farm system performance and profitability.
- It may be difficult to come up with a mitigation toolbox which contains blanket/rule of thumb responses to the mitigation tools available. For example; tools such as DCD, when applied to different farms, with a range of climate and soil types, resulted in variable responses.
- There are greenhouse gas benefits apparent from most of these systems. The average decline in the kg CO_2/kg MS is -12%.
- As these scenarios are developed through modelling they do not take into account the ability and skills of the managers/operators. In some cases when significant changes are made to the base system there may be a knowledge gap which may limit the system reaching the potential. In the modelling process, farms were maintained at a similar level of pasture harvest compared to the base, so were not optimized for pasture productivity in the process. There was some efficiency assumed as a result of the modelling process, such as higher per cow production, responses to supplement and feed utilisation parameters.
- The deficiency of a modelling process is that it does not depict well the sub optimal situation that occurs in real life systems. This needs to be taken into account when interpreting this data. Presently there is no field trial evidence that the more complex options will achieve the targets indicated.

Due to the **very small sample size it is difficult to draw meaningful conclusions, but there a number of key findings for farms of differing intensities:**

Intensive farms: The ROA[1] on the high intensity farms declined by -7% from their base when adjusted to low leaching scenarios. The average cost of change on these farms was a net loss of $30/kg reduction of N leached at a $5.50/kg MS milk price. These farms were of average to above average profitability to start with. The average cost of change had the highest impact on these more intensive farms.

Medium intensity farms: 2 of the 3 farms in this category increased operating profit and ROA when modelled from the base system at a milk price $5.50/kg MS to a system leaching only 26 kg N/ha. The average cost of change for these three farms was a net benefit of +$9.40 per kg reduction of N leached. At $4.55/kg MS this figure is a net benefit of +$6.24 per kg of N not leached.

Low intensity farms: 50% of the farms in this category increased operating profit and had a net improvement in total ROA when modelled from the base system at a milk price $5.50/kg MS to a system leaching only 26 kg N/ha. However the other 2 farms had a reduction in ROA. The average cost of change on these lower input farms was a net loss of $1.00 per kg reduction in N leached. The average impact on ROA was slightly positive.

Organic farm; There was only one organic farm used and this was on a 'high risk' soil type. The operating profit decreased significantly when modelled from the base system at a milk price of $5.50/kg MS to a system leaching only 26 kg N/ha.

Overall the sample was not "average" – In terms of MS/ha, 70% of the sample group were above average, and in terms of operating profit/ha; 80% of the sample group were above the comparable Dairy Base average.

In all cases, the farms historical pasture harvest was calculated using Farmax Dairy Pro (v6.3.61.2) and Overseer (v5.4.3). In almost all the case study farms, the farms pasture harvest was between 9T DM to 13T DM. In the course of modelling, the basal pasture harvest was maintained where possible.

A range of tools were used in various combinations in order to reduce the nitrogen leaching, this includes:

[1] Denotes Return on Dairy Assets (Operating Profit –lease on land/buildings)/Total Assets at start of year x 100. This has been assessed without capital gains. This percentage measure of profitability looks at the total return on assets employed and is a priority to consider in business performance. This measure can be compared between farms.

Reduction in Nitrogen fertiliser use: High risk applications which have lowest pasture response rates were removed first as this had the greatest impact. Some nitrogen use was maintained at the best response times of the year.

Effluent use was improved: The effluent was generally used to enhance the growth of summer forage crops, to lift the overall feed supply pattern, and support more summer milk with alternative feed sources. Additionally effluent holding ponds were often introduced to enable effluent to be stored over the winter and sprayed at optimum times.

Lower stocking rate (SR): In many cases, stocking rate was dropped between 15-25%. Total farm output was decreased by 9.5 %, while per cow production was lifted by 8% on average.

Cow production: In most cases this was increased, with the use of forage crops, and a reduced maintenance to production ratio. The total home grown feed (pasture conserved feed and forage crops) generally didn't diminish following a drop in stocking rate. The average increase per cow was +8% while the overall milk output across all the farms was diminished by -9.5%.

Young Stock Grazed Off: this was done from 120 days in most cases, rather than leaving them on farm until 9 months

DCD (nitrification inhibitor): this was used in some cases although responses varied and in some cases it wasn't a profitable option. It was commonly used where the option of winter grazing was not available.

Farm System Intensity: In most cases the farm system intensity was lowered. However, in a small number of highly intensive farms that already had the infrastructure such as a feed-pad the intensity was able to be maintained. (Farm system intensity relates to the level of bought in feeds and stocking rate)

Diet: Lower protein supplements (eg; maize) were selected over higher protein feeds. This increased the nitrogen conversion efficiency of the overall system.

Land Use Changes: Retirement of steeper areas of the farm to trees. An assumption was made that income could be derived through carbon credit sales and the income from harvest would cover the planting and maintenance and liability costs.

Infrastructure Change: Wintering barns (e.g. Herd Homes), feeding pads and/or wintering pads were used in some cases to target winter leaching losses, with longer periods on wintering or feeding pads for cows in the autumn and winter periods.

Recommendations

A range of parameters need to be considered when investigating the cost of reducing nitrogen leaching, not just the change in operating profit per kg reduction in N leached. It is important to consider the economic impacts across a range of areas of the business, including the total return on assets; operating profit per hectare which relates to overall profitability, and the operating profit margin which provides an assessment of business risk.

In several cases, there was a significant change in the operating profit/kg N leached from the base scenario, however once assets and liabilities were adjusted, this impact was less significant on the overall ROA.

This study has highlighted that individual farm businesses vary widely in their response to the suite of N leaching mitigation strategies that are presently available. This variability has implications for efforts to reduce nutrient leaching from farming at a catchment scale. Given the variability in responses, it is important that a rigorous analysis and planning process needs to be undertaken for each farm.

This business assessment will provide the grounds for appropriate "best management practices" to mitigate nutrient losses, while clearly understanding the business impacts of these practises. The analysis and planning process should provide clear guidance to farmers on the changes to their farm system required to meet identified nutrient targets, and include professional support through the implementation phase.

Contents

List of Tables

Introduction

Environment Waikato has growing concerns about the effects of intensive land use on water quality in the region[2] and these concerns are mirrored by river iwi. In 2006, Environment Waikato identified that agricultural practices were contributing to rising nutrient levels within the region's waterways, and particularly within the Waikato hydro lakes[3]. In response, they launched a three year intensive policy implementation pilot process, the Integrated Catchment Management (ICM) pilot project, within two of the region's sub-catchments (Little Waipa & Waipapa). The objective of the ICM pilot project was to gain an understanding of nutrient management in the farm setting and investigate the potential effectiveness of ICM approaches in achieving sustainable improvements in water quality[4].

Environment Waikato (EW) is seeking input from the Primary Sector on ways to reduce nutrient losses from farms in the Upper Waikato Catchment. The ICM work to date has provided a large amount of information and learning around farm practice changes that increase nutrient efficiency, however, the work has very limited information around the financial implications of nutrient mitigation scenarios.

The current project, part of the wider ICM work for 2009-10, stems from a partnership between EW, Ballance Agri-Nutrients (Ballance), DairyNZ and Fonterra. The project aims to assess the current nutrient use efficiency of a selection of dairy farms and identify options for further efficiency gains and their associated costs to the farm business. This work aims to provide information that may aid target setting in the region and to ensure policy development occurs with sound science backing. In time this work may inform other industry initiatives and provide on-farm information for regional policy development.

Present Situation

Currently NMPs are being done in sensitive catchments as part of addressing the priority rules as set out by EW. Environment Waikato permitted activity rules requires all farmers in sensitive catchments to have a NMP written, and implemented, if they are using more than 60 kg of N/ha/year.

At the farm level, presently the pastoral industry is operating with guidelines (e.g. Fertiliser Industry Code of Practice for Nutrient Management). Educational incentives are all that is presently operational to encourage change.

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[2] "The condition of rural water and soil in the Waikato region: risks and opportunities" www.ew.govt.nz

[3] "Water Quality effects of land use changes in the catchment of the Waikato River hydrolakes" Bill Vant December 2006. Notes for EW meeting 13 December 2006.

[4] Hungerford, R. (2009). Evaluation of the Integrated Catchment Management Pilot Project - final report June 2009. Environment Waikato Technical Report 2009/17.

At the industry level, there are targets in place to direct change and implementation of best practice, but these are all voluntary. An example of some of the mutual agreements in place;

- Primary Sector Water Partnership Leadership Document (2008)
- Dairying & Clean Streams Accord
- The Sustainable Water Programme for Action (MfE)

Pressure within the Upper Waikato Catchment

Waikato River Co Management Agreement (in principle) Guardians for the Waikato River.

Under the terms of the Agreement in Principle, the overarching principle of the proposed settlement is "**to restore and protect the health and wellbeing of the Waikato River for future generations."** The implementation of the Vision and Strategy will be overseen by a permanent organization called the Guardians of the Waikato River.

As part of the strategy document, in objective G, the proposed strategy states "**the recognition that the Waikato River is degraded and should not be required to absorb further degradation as a result of human activities."** [5]

Why target 26 kg N/ha/yr for Dairy and 12 kg N/ha/yr for Sheep and Beef?

The study is focused on assessing the financial implications of change on dairy farms to reach a target of 26 kg N/ha/yr, and sheep and beef farms to reach a target of 12 kg N leached per ha.

The rationale behind this is based on research that highlights what changes need to be made within pastoral systems to reduce the cumulative impact on water quality in the Waikato hydro lakes in the future.

The leaching loss figures are from a 2006 study done by Bill Vant (Environment Waikato Water Quality Scientist), on the water quality effects of land use changes in the catchment of the Waikato River hydro lakes. In that study, scenarios of change were assessed, looking at a range of scenarios that considered the effects of further conversions, the impact of the pine to pasture conversions, as well as continued intensification of both dairy and Sheep and Beef farming within the catchment. Five scenarios were looked at in detail, and the impacts of these land use changes to 2030 compared to 2006.

[5] Guardians Establishment Committee; Proposed vision and strategy consultation document.

For example, if nitrogen leaching were to be maintained at their current levels, with around 36-40 kg N leached per ha from the average dairy farm in the Waikato, it appears that the combined loads from the land use changes to 2030 will increase by around 26%. Reducing loads by implementing "best practice" reduces the increase to only 17% above where it is now. However to have no increase, and to maintain nitrogen loads at their current levels, both capping and reducing loads of nitrogen lost from pastoral farming is necessary.

Reducing leaching losses to 26 kg N/leached/ha/yr for dairy and 12 kg N leached/ha/yr from Sheep and Beef farms would result in no further degradation of water quality in the hydro lakes. All other scenarios produced moderate to large increases in the load of nitrogen entering the hydro lakes.[6]

Constraints of the Report

The authors have used the latest versions of Overseer Nutrient Budgets (version 5.4.3) and Farmax Dairy Pro (6.3.61.2) to develop the system changes, and model the economic effects. The authors acknowledge that there are limitations due to the use of two models being used together, and that the validity of some of the assumptions made by the models may be questioned due to the constraints of the modelling used.

Some of the limitations which have been discovered in the use of these modelling programs include:

- In Overseer, the inability to apply farm effluent to the forage crops presented a challenge. This means that the benefits of growing crops on the effluent block and therefore increasing nutrient uptake by the plants and reducing the imported fertilizer required are not fully recognized. We have assumed that forage crops generate a modest yield with only the use of effluent (no other fertiliser was used and effluent was stored for no longer than 3 months prior to application). We used Chicory as a pastoral crop in Overseer as it is grazed as regularly as pasture in the summer months.

- The reporting of the pasture harvested between Farmax Dairy and Overseer showed discrepancies due to the slightly different assumptions and methods of calculation between the two programmes. This may result in a difference of 5-6% in overall leaching assumptions between the two models due to lower assumed total pasture harvest by Overseer. This is especially pronounced in the models of high intensity scenarios. The designers of Farmax and Overseer have acknowledged that this needs to be addressed.

Long term average conservative milk prices have been used to sensitize the models.

Two milk prices have been used in the analysis; $4.55 to represent the likely lower range in further payouts and $5.50 which is an estimate of the longer term average milk price in the future.

[6] "Water Quality effects of land use changes in the catchment of the Waikato River hydrolakes" Bill Vant December 2006. Notes for EW meeting 13 December 2006.

Methodology

The authors sought confirmation of the study approach, actual farms involved and proposed scenarios (NMPs) from project sponsors and then undertook the following procedure for analyses

Project Concept

The case studies approach comprises of 14 farms. This sample includes 10 dairy farms, 4 sheep and beef and deer farms, and 1 'average Waikato dairy farm' modelled from DairyNZ economic survey information. The sample includes a range of farm systems and intensities. The farms were selected by Ballance Agri-Nutrients staff and are all located in the Upper Waikato Catchment.

It was not intended that the farms give an exact representation of the demographics of farming in the catchment.

The farms have been modelled for economic outcomes of a range of proposed nutrient management options that were presented in Nutrient Management Plans (NMP's) provided by Ballance.

Each of the farms were modelled in Farmax Dairy and Overseer to represent the current farm systems in place. This provided base information covering physical, financial, and environmental elements of the business. These models were then adapted to model the scenarios presented in the NMP's developed by Ballance Technical Sales Representatives (TSR's). Comparisons were then able to be made between the NMP models and the base model.

Kg MS as % of live weight in the efficiency area, is reported from Farmax based on the total MS for the year, divided by the cow live weight on the 1st of Dec. Hence this can appear to be higher than if it were reported on the first day of calving.

1. Farm Visit: Following assessment of NMPs and other material provided by Balance TSR's, the authors carried out initial visit to each farm. In most cases this visit was carried out without a TSR from Ballance present. The data required for the development of the physical and financial models were collected on the day of the visit. Alignment of the NMP with the farmer's goals and direction was also checked.

2. Economic & Systems Modelling and Scenario Plans: Collation of farm specific (historical) data, full entry into relevant model for analysis, and validation of the long term (historical) model was carried out. The collation of a long term ("year in – year out") expenses model for the business was applied to Farmax. This was a mix of historical information that was available and also based on likely scenario planning for costing and expense adjustments that may apply and be relevant in the future. This was based on actual farm characteristics, historical accounts, and took into account the effects of drought events. We acknowledge that there have been some adjustments needed for the 2007-08 or 08-09 year due to adverse climatic conditions. In the drought years, it was apparent that pasture harvested was around 0.3-0.5T DM per cow lower than in previous years. In many cases, this would have amounted to a drop in pasture grown of around 1.5 T DM/ha. As a result, we adjusted the base models to reflect more normal growth rates, and subsequently more normal pasture yields on the case study farms. Some cost changes (where applicable) were made as a result of the scenarios. The scenarios provided in the NMP were modelled and validated.

3. Detailed Economic & Efficiency Analysis: In order to provide defendable and robust financial results in terms of the full assessment of potential profitability, risk, efficiency and changes to capital position, we have provided more in depth indicators than those normally provided in Farmax Dairy.

Operating profit was exported to an excel spreadsheet which was then used to derive the KPI's for the farm financial data.

Pasture harvested as reported in Farmax is actually "pasture allocated". This is 10% more than what is actually eaten. Hence we have adjusted that to a figure that reports pasture harvested, and derived a kg DM/kg MS parameter from that. It appears that this figure might still have a variability of 3-4% when compared with similar programmes or calculations.

Farmax only provides an operating profit summary. Key financial performance indicators such as return on assets (ROA), return on equity (ROE), and changes in debt ratios were taken into consideration to give more useable information back to the case study farmers. Along with these, the altered physical, risk and efficiency indicators of the business under different scenarios have to be taken into account to allow defendable recommendations to be made.

We have presented the relevant data in summarized and detailed KPI tables in the body of the document as well as in the appendices.

We have also detailed what assumptions have been made on the basis of the farm modelling with each table of KPI's. These tables are able to be viewed for each farm in the appendices.

4. Individual Impact Analysis for Each Farm at low nutrient loss scenarios: The next step in our procedure took into account the results from each individual farm, using all the relevant outputs and considering the proposed scenarios using a SWOT analysis for each entity. There has been consideration given to the financial, physical, social and environmental impacts of the proposed system changes.

5. Overall Impact Assessment: This is a discussion and summary covering the overall impacts on the businesses involved. Where it was possible, conclusions were drawn about the long term viability and economic impacts of the proposed system changes provided to us and our interpretation of best management practices (BMP's) for these various businesses in the future.

6. Mitigation Costs: Presentation of the scenarios showing the costs of mitigation for each farm under the low nutrient loss scenarios analysed.

7. Suite of Best Practise & Practical Guidelines for Farmers: From the information collated, we drew together the findings of the study. It is likely that for different farming intensities, there will be different best practise guidelines that will be relevant.

This report underwent review by the Project Sponsors (EW, DairyNZ, Fonterra and Ballance) on two occasions. Dr Bruce Thorrold (DairyNZ) provided expert technical review.

Economic Summary of Low Nutrient Scenarios

High Intensity Case Study Farms

Three of the eleven dairy farms in this project fell into the category of being highly intensive from the sample group. These farms are bringing in 5-10TDM/Ha to the milking platform. They would fall into the classification of system 4 or 5 under the Dairy NZ intensity classification. The economic impact of reducing their nutrient leaching to 26 kg N/ha has been shown in Table 1. Scenario 1 denotes lower leaching using grazing off in winter as an option, while Scenario 2 depicts lowering leaching while keeping all cows wintered on the farm

Medium Intensity Case Study Farms

Medium intensity properties are those that are importing between 2-5T DM supplement per ha for the purposes of this sample group.
They would be aligned to systems 3 in the Dairy NZ farm systems assessment. Three of the eleven dairy farms in this study fell into this category. The economic impact of reducing their nutrient leaching to 26 kg N/ha is shown in Table 2.

Low Intensity Case Study Farms

Low intensity properties are those that are importing between 0-2T DM supplement per ha for the purposes of this sample group.
They would be aligned to systems 1 and 2 in the Dairy NZ farm systems assessment. Four of the eleven dairy farms in this study fell into this category including the average Waikato dairy farm model. The economic impact of reducing their nutrient leaching to 26 kg N/ha is shown in **Table 3.**
These lower input operators tend to run lower input systems, with responses to dry summer/autumn periods forcing them to purchase more bought in feed to maintain stock numbers. Hence some characteristically low input systems drift into medium input systems in dry or difficult years.

An Average Farm was modelled, to compare the sample group against what might be assumed to be an average Waikato farm for the year of 2009-10. The basis of the model was provided form Dairy NZ based on Dairy Base data. It has been adjusted for $4.55 and $5.50kg MS.

In the following Tables 1 to 4, the "Base Model" depicts the case study farm as per a "year in year out position, using the current practises.

"**Scenario 1"** denotes lower leaching using "winter grazing off" in the catchment as an option. This may not be available as a long term mitigation tool.

"Scenario 2" depicts lowering leaching while keeping all cows wintered on the farm. A range of mitigation strategies have been used to achieve a lowered leaching rate of 26 kg N/ha/year.

Table 1: The economic impact of change on intensive dairy properties. $5.50/kg MS

	Average [1]	DBM3	DBM3	DBM3	AD1	AD1	AD1	AD2	AD2	AD2
		Base	Scen 2	Scen 3 (winter-on)	Base	Scen 2 (winter off)	Scen2 (winter on)	Base	Scen 3 (winter off)	Scen 3 (winter on)
Scenario				AGF [2]		AGF	AGF		NMP	AGF
Kg N Leached/ha	**36-50**	**44**	**36**	**26**	**31**	**24**	**26**	**54**	**26**	**26**
Op Profit per ha	$1490	$3694	$3658	$3141	$2625	$2607	$2394	$2012	$1927	$1646
Op profit less debt/ha	$896	$2439	$2403	$2189	$1972	$1955	$1742	$1498	$1412	$1465
Return on Assets %	**4.15%**	**8.77%**	**8.68%**	**8.50%**	**6.12%**	**6.08%**	**5.59%**	**4.70%**	**4.50%**	**4.27%**
Op Profit Margin%	26%	31%	30%	36%	32%	30%	29%	24%	30%	29%
Kg MS/ha	967	1965	1963	1543	1377	1367	1354	1487	1126	987
Kg MS/Cow	328	512	511	514	492	489	491	434	464	450
Past.harvest T DM/ha	11.2	12.9	13.02	12.47	10.82	10.37	10.82	12.66	10.94	10.22
T/Supp/imp/ha	1.6	11	10.3	5.75	5.7	5.89	6.55	5.8	1.47	1.9
Kg DM/kg MS	13.2	12.1	12.2	11.9	12	13.5	14.2	14.4	11.2	13.3
Diff.kg N leached			-8	-18		-7	-5		-26	-28
N conversion efficiency	26	37	41	49	38	36	35	32	44	41
GHG/kg MS	11.3	7.8	7.5	7.3	7.6	8	7.6	9	8.1	7.7
*$ change in kg N leached	NA	NA	**-$5.70**	**-$31.26**	NA	**-$2.57**	**-$46.20**	NA	**-$4.02**	**-$13.59**

* denotes that the cost of any new debt servicing has been taken in to account. That is debt for infrastructure changes which allow the low nutrient leaching scenario to be possible. (1)The average is from Average Waikato, Dairy NZ budget 09-10 standardised for milk and feed price.(2) AGF; Agfirst Scenario

Table 2: The economic impact of change on medium intensity dairy properties $5.50MS

	Average	JA1	JA1	JA1	NW1	NW1	NW1	NW2	NW2	NW2
		Base	Scen Two winter off	Scen3 winter-on	Base	Scen 2 winter off	Scen2 winter on	Base	Scen 3 winter off	Scen 3 winter on
Scenario			NMP	AGF		NMP	AGF		AGF	AGF
Kg N Leached/ha	**36-50**	**65**	**27**	**26**	**34**	**26**	**26**	**44**	**25**	**26**
Op Profit per ha	$1490	$3130	$1925	$2572	$1255	$1101	$1557	$941	$1464	$1040
Op profit less debt/ha	$896	$1128	$279	$570	-$48	-$202	$253	$86	$608	$184
Return on Assets %	**4.15%**	**4.18%**	**2.57%**	**3.44%**	**3.6%**	**3.16%**	**4.47%**	**3.08%**	**4.79%**	**3.40%**
Op Profit Margin%	26%	34%	35%	32%	19%	19%	24%	20%	30%	22%
Kg MS/ha	967	1577	935	1355	1118	987	1133	800	836	821
Kg MS/Cow	328	472	503	551	405	387	419	328	377	376
Past. harvest T DM/ha	11.2	12.48	8.94	10.46	9.84	9.74	10.15	9.83	9.32	9.46
T/Supp/imp/ha	1.6	4	0	3.52	3.6	1.92	3.68	2.21	0.61	2.38
Kg DM/kg MS	13.2	11.9	9.6	11.2	12	11.8	12.2	15	12	14
Diff. kg N leached			-38	-39		-8	-8		-19	-18
N conversion efficiency	26	30	47	49	33	37	34	19	26	21
GHG/kg MS	11.3	8.5	9.1	7.4	8.5	8.5	8.5	12	9.8	10
*$ change in kg N leached	NA	NA	**-$31.71**	**-$14.31**	NA	**-$19.21**	**+$37.75**	NA	**+$27.77**	**+$5.42**

This * denotes that the cost of any new debt servicing has been taken in to account. That is debt for infrastructure changes which allow the low nutrient leaching scenario to be possible. (NMP) indicates Scenario provided. (AGF) indicates Agfirst scenario.

Table 3: The Economic Impact of change on lower intensity dairy farms at $5.50/kg MS

	Av Waikato	Average	Average	PG1	PG1	PG1	DMCD1	DMCD1	DMCD1	DBM1	DBM1	DBM1
	Base	**Winter off**	**Winter on**	**Base**	**Winter off**	**Winter on**	**Base**	**Winter off**	**Winter On**	**Base**		**Winter on**
Scenario		2	3		2	3		2	3		1	2
Kg N Leached/ha	**50**	**26**	**26**	**45**	**26**	**26**	**38**	**26**	**26**	**42**	**32**	**26**
Op Profit per ha	$1490	$2013	$2429	$2140	$2458	$2167	$1528	$1293	$1497	$1731	$1570	$1420
Op profit less debt/ha	$896	$1008	$1424	$1129	$1447	$1224	$1064	$828	$801	$595	$441	$297
Return on Assets %	**4.15%**	**5.61%**	**6.77%**	**5.55%**	**6.44%**	**5.74%**	**5.27%**	**4.46%**	**4.69%**	**4.15%**	**3.77%**	**3.43%**
Op Profit Margin%	26%	34%	37%	32%	36%	37%	34%	26%	31%	25%	23%	22%
Kg MS/Ha	967	1016	1118	1150	1161	983	799	860	861	1176	1187	1094
Kg MS/Cow	328	414	458	393	442	425	369	396	396	460	460	466
Past.harvest T DM/ha	11.2	10.9	10.8	11.8	11.6	11.12	10	9.07	9.27	11.55	11.55	10.85
T/Supp/imp/ha	1.6	0.37	2.18	1.42	0.21	0.15	0.39	1.41	1.73	1.87	1.87	1.98
Kg DM/kg MS	13.2	11.16	11.9	11.7	10.2	11.5	12.9	12	12.5	11.7	11.6	11.9
Diff.kg N leached		-24	-24		-19	-19		-12	-12		-10	-16
N conversion efficiency	26	47	38	31	46	42	24	33	32	42	32	26
GHG/kg MS	11.3	8.5	8.8	9.9	7.7	8.7	10.8	9.6	9.6	8	7.3	7.1
*$ change in kg N leached		**+$21.81**	**+$35.62**		**+$15.85**	**+1.44**		**-$19.62**	**-$21.93**		**-$16.10**	**-$19.44**

This * denotes that the cost of any new debt servicing has been taken in to account. That is debt for infrastructure changes which allow the low nutrient leaching scenario to be possible.

Economic Impact of change on Organic Properties

The impact of change on an organic farming property on a highly sensitive soil type was also considered. This farm did not have all the mitigation options available to it that the conventional farms had, hence it was considered on its own. The economic impact of reducing the nitrogen leaching to 26 kg N/ha is shown in Table 4.

A "sample group" of similar organically farmed properties would be required to draw any meaningful conclusions from this exercise.

Table 4: The Economic Impact of Change on the Organic Dairy Property at a $5.50 milk price

	DBM2		
Business and Physical	Base $5.50	Scen1 NMP $5.50	Scen 2 $5.50
		NMP	AGF
Operating Profit/ha	$2673	$2606	$1971
Operating Profit Less Debt servicing	$1164	$1097	$458
ROA%	6.44%	6.28%	4.88%
Op Profit margin %	54%	54%	53%
MS/Ha	868	858	741
MS/Cow	380	426	521
Pasture Harvested/ha	10.34	9.93	9.57
Kg DM/kg MS	12	11.6	13
Environmental			
Change in kg of N leached		-3	-12
Kg of N leached	38	35	26
$ change in op profit/kg of N leached		**-$22.33**	**-$58.50**
N conversion efficiency	37	38	42
GHG/kg MS	10.3	10	8.7

Summary of Impacts of Change due to Compliance

Table 5: Average Change in Operating Profit/ Change in Kg N leached for Conventional Farms at Milk Prices of $4.55 & $5.50

Milk price	Wintering Off and Lowering Leaching to 26 kg	Wintering On and Lowering leaching to 26 kg
$4.55	**+0.70c/kg Change in N**	**-0.60c/kg Change in N**
Range	-$15.70 to +$25.96	-$41.80 to +$36.25
$5.50	**-$3.35/kg Change in N**	**-$6.65/kg Change in N**
Range	-$19.62 to +$27.77	-$46.20 to +$36.75

The above table provides averages of the range of costs to a farm for the change in leached N.

This is derived using the difference in operating profit of the low leaching scenario compared with the base model scenario, and dividing it by the total change in nitrogen leached per ha, per annum.

This result is positive for some farms, and negative for others, giving a misleading figure when it is averaged.

This exercise however does reinforce the importance of looking at each farm on an individual basis, and from there, considering an approach forward. For some farming systems, there will be a positive effect, for some there will be a negative effect.

Table 6; Changes in ROA on Conventional Farms

Conventional Farms	ROA % Base $4.55/MS	ROA % Base $5.50/MS	ROA % Low Nutrient Scenario $5.50 MS	$1 change in Milkprice From $4.55 to $5.50 Effect on ROA%	Compliance Effect on ROA%
DBM3	4.16	8.77	8.5	211%	-3%
AD1	3.08	6.12	5.59	199%	-9%
AD2	1.4	4.7	4.27	336%	-9%
JA1	2.18	4.18	3.44	192%	-18%
NW1	0.58	3.6	4.47	621%	+24%
NW2	0.59	3.08	3.4	522%	+10%
Ave	1.62	4.15	6.77	256%	+63%
PG1	2.91	5.35	5.74	184%	+7%
DMC1	2.68	5.27	4.69	197%	-11%
DBM1	1.48	4.15	3.43	280%	-17%
Average Impact on ROA				**300%**	**+4%**

Table 5 highlights the relative change in ROA on dairy farms that a one dollar change in milk price can have on a whole business, as well as the modelled impact on a farm of meeting low nutrient scenarios. For comparison, the 2007-08 drought year reduced the ROA on the average farm by -47%, (at a $5.50 milk price, the ROA dropped from 4.15% to 2.21% as a result of drought impacts.)

It is important to note that this effect of compliance on ROA as presented by the models appears to be less significant than milk price and volatile weather events. **However an additive effect of pressure for compliance on a business and social resources is an essential consideration that is not well represented by numerical measures.**

Sheep and beef operations are far less homogeneous in their management and systems; hence a comparison such as this, as demonstrated for dairy, is more complex to do and is not able to be done with the case study farms in this project.

The effect of change is more pronounced, on higher intensity farms, at a higher milk solids payout.

Milk Price Change and volatile weather events have a large impact on farm profitability and the cost of change due to compliance needs be kept in perspective.

It is important to note, the above effects represent the effect on a more intensive sample group than the "demographic average" for the area.

70-80% of the sample group was above average for kg MS per ha and Operating Profit per ha.

In all cases, it should be emphasized that the changed scenarios assume that operator skill is not limiting. In all of the scenarios, there would need to be a level of up skilling by the farmers to allow the changed scenarios to operate as we have assumed in the models.

Discussion

The options available for change are variable for each farming business. It is imperative to understand that each mitigation option will have a different effect, on each farm or business.

This is because all farms are unique. They have different physical characteristics, financial and social profiles. Hence a "one size fits all" recipe or toolbox could be precarious if used poorly.

There were, however recommendations and strategies adopted by the modelling team for each individual farm that resulted in lowering of N leaching. In each farm business, the action resulted in a different financial result. Hence, there was no common financial implication of the mitigation tool.

The project has required development of detailed understanding of individual farm businesses.

The base farm system in place has different endogenous (e.g. farmer ability) and exogenous (e.g. climate/LUC etc.) drivers that have shaped it. The authors believe that in all cases, in order to be able to develop a sound nutrient management plan (NMP) for farmers, there needs to be **one-on-one engagement with the owner/operators at the outset.**

There is a real opportunity that the process of delivery of NMP's can be used to stimulate better financial and business literacy as part of the process. This in itself will be a major step forward for the industry as a whole. However, if the NMP process is handled inappropriately or poorly at the outset, there is a threat that response to recommendations may be impaired in the future, as a result of poor delivery and acceptance.

If the NMP is delivered as part of a suite of services that include an initial social assessment, a historical business assessment, and proposed financial report along with a whole farm environmental plan, it is possible that the industry may find opportunities to improve environmental outcomes and also improve business performance, financial and business literacy in the industry, and in some cases, greatly improve financial performance in the process.

From this, a picture of the farm system, its profitability, and its ability to be more flexible in the future needs to be assessed.

Proposed change needs to be built on the back of this individual information. Recommendations need to capture the business owner's goals, drivers, stage in the business cycle, and financial capability. These plans also need to detail the impacts of a system change on the social, economic, physical and environmental aspects of the business.

The authors have attempted to take these into consideration with a SWOT analysis of the impacts of the proposed farm system changes to low nutrient leaching scenarios.

In the future, for extension purposes, it will be necessary to create a forum that hosts creativity and innovation from leading farmers, either on a one-on-one basis, or in a think-tank type discussion group forum.

Strategies used when comparing current with proposed models.

The economic comparisons were made by looking at the change in profitability of the low nutrient loss model, to the base model. The low leaching models aimed to retain consistency in the following areas where it was possible.

- Pasture harvested per Ha, the models were not optimized for this, and it was assumed that the level of pasture management would remain similar, to what had been derived from the case study data.

- Stocking Rate – Where stocking rates in many cases had to be reduced by 15-20% to achieve lower nutrient leaching scenarios, there was the use of spring sowing of summer crop to enable more area to be dropped out at the spring peak. This raises the effective stocking rate over the graze able area when pasture growth is high thereby maintaining overall pasture quality.

- Lowered N use, in many cases the N use did have to be lowered. Adjustments to pasture grown and harvested were taken in to account by Farmax. This was reported as a lower overall pasture harvest, due to the lower use of N and the consequent loss of potential pasture grown.

- DCD – it was assumed that DCD was applied within a week of grazing, and that there was a 2% increase in growth rate between April and October. The cost of this has been included at $94.50 x2=$189.00 per ha in two applications

- Grazing Off – Where this was used, it was factored in at market rates of $22 per cow per week.

- Dietary management – Where cows were producing more, at a lower stocking rate, it was assumed that sound dietary management principles were being followed. We acknowledge that in many cases there would be a role for a nutritionist in some of these models to ensure sound management practices were being followed to ensure there are no sub optimal dietary issues negatively impacting on the feed conversion efficiencies.

- Per cow production – **In many of the lower leaching scenarios, the per cow was improved on average by an average of 8% across the conventional sample group due to the effects of slightly lowered stocking rate (15-20%).**

  Many of the case study farms were reasonably high per cow producers, so where high per cow production was used at a lower stocking rate, there was the use of a larger cow in many cases, graze able summer forage crops and more silage made at spring.

  In many cases the option of both improving the summer feed supply pattern, along with the importation of low protein feed such as maize were used. This had a twofold effect, both to enhance summer milk supply and gain better milk production at a time when traditionally it drops away quite quickly in the Waikato due to the lower growth rates and anti nutritional effects of ryegrass. The importation of some maize also assisted with wintering on options. Where it substituted nitrogen boosted grass, there was the additional benefit of lowering the total nitrogen present within the system. This was reflected in the nitrogen conversion efficiency.

- Total Production Changes Per Cow; **The average lift in per cow production on the conventional farms was 8%.** It is important to note that the largest change to the per cow production was in the average scenario. This farm also

had the lowest per cow production of the sample group to begin with. Hence, the differential seemed the most significant. The low nutrient model for this farm lowered stocking rate from 3.15 to 2.5 on land that was harvesting 11.2T Dm/Ha, which is typical of the average Waikato farm. The per cow rise was due to cows consuming more overall pasture and summer crop, taking per cow intake from 3.58T Pasture per cow per annum to 4.52 T DM harvested per cow per annum. Supplementary maize (0.9TDM/Cow) was also fed. Efficiencies were gained through a better production to maintenance ratio. Also, a larger cow was assumed in this model to facilitate total pasture eaten at a lower stocking rate. Pasture control in the spring peak was aided by dropping 10% of the farm out for crop, and also dropping slightly more area out for silage. There would be both gains and losses in efficiency in this model.

- Total Production Changes Per Farm; **the average change in production at a farm level was a drop of 9.5% in total milk output.**

- Grazing Off; Where grazing off was not used in the final scenarios, adaptations were made such as the use of feed pads, more supplement for the dry cows on the pad, collection of effluent from the pad, and re use on minimum tillage crops in the subsequent spring.

Behaviour and Feedback

Presently there are no clear boundaries in place to set direction for change at a farm level. There are targeted education programmes from Dairy NZ, Waikato Regional Council (WRC), and private advisory groups.

Farmers are presently not clear what the potential changes to their operational environment will be, and as a result are giving feedback that some leadership or clear education in this area would be beneficial to allow them to begin to plan ahead, for farm system adaptation and investment purposes.

Feedback from some of the farmers involved in the case study is shown below;

"Give us some direction, and we will make changes. If we don't have any clear direction, we won't change"

"Leadership in this area is not presently clear, what are we supposed to do?"

"What do these Nutrient Management Plans mean?"

"What about herd homes- are they worth it?"

" I will sell the farm if they make me do that", was the reply of one farmer when he saw the scenario for the reduction in N leaching to 26 kg presented in a NMP.

"When do we start adapting to change – and lowering N leaching? i.e.; if "grand parenting" were to be used as in the Taupo catchment, are farmers best to continue with current practises until after such regulation is in place to give higher N allowance."

Trend to higher intensity systems (dairy)

This section has been included to provide some context for discussion around the relationship between feed input systems, profitability and eco-efficiencies.

This may be multi factorial in nature. Over the last two decades systems have intensified through increased use of Nitrogen fertilizer, increased stocking rates, and increased use of supplementary feed. Refer to DairyNZ Economic Survey 2007-08 for more detail.

In recent years a few more volatile seasons have made operators consider their risk profile, as summer rainfall patterns have become somewhat less predictable in the past 2-3 years.

Chris Glassey's [7] work looking at summer pasture growth variation showed that there is a 66% chance that, in summer, 3 months (Dec to April) out of 5 will have lower pasture growth than demand. This work also showed that there is a 33% chance that 4 of the 5 months will be in deficit, due to low summer rainfall. This can lead to up to 1 T DM difference in pasture available per cow between a good year and a bad year, as was the case in the Waikato during the 2008 drought.

Volatility like this can have a significant impact on the business bottom line. On this basis, farmers have opted to reduce their risk by attempting to control their feed supply. It is also likely that the increased availability of by-products, via the importation of Palm Kernel Expeller (PKE) and Copra have helped drive prices back to a competitive level, where the milk price: feed price ratio allows more profitable feeding. In the modelling at $5.50/kg MS the milk price: feed price ratio sits at $5.50/kg MS for milk and 27.5 cents per kg for feed. At this ratio of 5%, on an efficient farm, there is opportunity for more profit to be derived from supplementary feed use.

Continued improvement in the genetic merit of cows means that for every 100 cows on farm, an adjustment in stocking rate of 1 less cow per year should be made, to compensate for the higher feed requirements of these higher BW cows. That would amount to a herd of 300 cows reducing numbers by 30 cows over a ten year period to allow the feed demand: supply ratio to remain at a status quo. Alternatively, the option would be to remain at the same stocking rate, and purchase the feed in to match the increased demand from the gains in genetic merit achieved on the average farm.

Higher land prices and increased debt, has driven a need to have higher output and profit per hectare to service debt and achieve improved returns.

Many smaller farmers are land locked (i.e., they are unable to purchase additional land nearby to expand.), and this alone has meant that they have had to intensify to lift productivity. With intensification there is higher risk, this leads to a need to increase feed purchased to fill the deficits, and reduce the risk of a poor return.

Finally, many farmers are motivated to feed their cows better, and lift production.

These are possibly some of the factors behind this lift in intensity of farm systems

[7] Glassey, Dairy NZ. Summer Pasture Growth Variation in the Waikato. A modeling exercise investigating the summer risk for pasture growth on a Waikato Dairy Farm. (unpublished 2006)

Table 7; Strengths, weaknesses, opportunities and threats of the nutrient efficient farm models.

Strengths and Opportunities	Weaknesses and Threats
• Environmentally compliant • Lower risk • In some cases more profitable • Lower GHG emissions • Lower intensity, reliance on bought in feeds in some cases • More self sufficient • Long term asset values maintained • Opportunity for eco labeling and market transparency	• Lowered profitability in some cases • Lowered returns in some cases threaten viability • Shift in system styles may require higher technical ability • Change may make system more risky it involves higher per cow production at a lower stocking rate. • High dependence on winter grazing in first scenario • All cows wintered on using feed pads for long periods can pose welfare issues.

The above table summarises the key impacts and opportunities on the businesses as a result of the change to low nutrient leaching scenarios, for dairy. These pertain to models where all cows were wintered on the farm.

Table 8: Extension Tools; Options for Reducing N leaching on Upper Waikato Soil Types (based on available mitigation options in overseer)

OPTION	POTENTIAL % REDUCTION in N LEACHING	ISSUES TO CONSIDER IF USING THESE OPTIONS
Self Assessment		Whole farm business and systems analysis should be undertaken prior to adoption of mitigation options. This will clarify land capability and the most suitable mitigation options**.**
Lower Nitrogen Use **(No winter Use, and lowered overall use)**	15% (10-20%)	No N use in the winter period, along with N applications only at the high growth times of year (10-12 kg DM Response) Where N use is high, this can be a profitable option at present prices.
Better Capture of Effluent and use on Graze- able forage crops without extra N use.	12% (10-15%)	Crops must be graze able forage crops such as chicory or regrowth crops that do not allow a prolonged soil mineralisation period. Minimum tillage & effluent application was used in the crop establishment and yields reflected this.
Lower Stocking Rate by 10-25%	12% (3-20%)	Results can be variable depending on soil types. This can be a profitable option on highly stocked farms, but pasture management skills need to be sound to maintain pasture harvest levels.
Nitrification Inhibitor **DCD**	10% (0-10%)	The response to this was variable and greatly depended on the level of leaching and the soil type.
Infrastructure Change/Feed pad/Standing cows off and capturing effluent	9% (3-15%)	This was variable, and assumed effluent capture in to ponds/storage and re use on summer crops. Costs of infrastructure changes included. Time standing on pads in winter and autumn need consideration. Generally was a cost to the business. Needs to be considered in line with better effluent capture and usage.
Higher per cow production /lower stocking rate, using low N supplements	7% (3-10%)	Via improvements in N conversion efficiency of the system, this was a sound option, but only if feed was at 5-7% of milk solids price. This option allowed productivity levels to be retained, and can reduce negative effects on profit if managed well. This will need to be done with a sound skill level.
Alter sources of bought in feeds from high protein to low protein sources	3% (0-5%)	In cases where a low protein feed source is available at a similar price, this did not negatively impact on profitability. Improved nutrient efficiency through higher N conversion efficiency.
Land Use Change	3%	Where small areas or sidling could be retired from pastoral use and planted, this was used, an income from the agro forestry was assumed.

Alternative Options		Issues to Consider if Using these Options
Grazing Off In Winter within the Catchment	20% (15-25%)	Where this practice was used, it allowed the most effective, and profitable way to lower N leaching. However this practice is not suitable as an option in a sensitive catchment.

(*assumptions are based on milk prices of $4.55 and $5.55, the bought in feeds at $270 per tonne.)

Conclusion; Tailoring the message

This study has a small sample size and care should be taken with the assumptions that have been derived from these observations.

A common suite of practises cannot be applied to all farms. All farms are unique.

Higher intensity farms are more sensitive to the change, but on the flip side to this, these farms are generally are run by very competent operators, who are "good adapters to change" and who may well come up with clever mitigations to allow them to continue to operate in an nutrient constrained environment.

Whole farm management plans are the most appropriate way to deliver this message effectively. The change implicated in these scenarios will need careful planning over time, and in some cases, there will be resistance to this change. In the future, for extension purposes, it will be necessary to create a forum that hosts creativity and innovation from leading farmers, either on a one-on-one basis, or in a think-tank type discussion group forum.

One-on-one engagement, with an initial assessment of a farm business will begin this process. An educated journey with feedback mechanisms operating, whereby business and nutrient plans are re assessed and adjusted over a number of seasons, is the most likely way that effective change will be achieved.

Sheep, Beef and Deer Summary

	SL1		DMCSB 1		SL2		DMCSB 2	
	Base	**Scenario 1**	**Base**	**Scenario 2**	**Base**	**Scenario 1**	**Base**	**Scenario 1**
Operating Profit $/ha	$537	$711	$430	$158	$84	$254	$162	$47
ROA	5.94%	7.76%	2.58%	0.95%	0.93%	2.81%	1.55%	0.47%
ROE	4.59%	7.60%	1.60%	-0.34%	-4.45%	-1.15%	0.71%	0.03%
Equity %	60%	61%	85%	85%	57%	57%	89%	94%
Tonnes Pasture grown	6.17	7.44	8.68	7.1	6.57	6.88	6.7	4.2
Liveweight wintered (kg)	833	947	920	562	652	378	1098	731
kg DM/kg Product	23.62	22.71	41.55*	43.31*	24.18	23.13	32.4	27.9
Kg N leached/ha	12**	14	18	12	15	12	20	12
$ change in OP/change kg N leached	NA	$87.29	NA	-$ 61.41	NA	$ 56.52	NA	-$18.56

Note:*One of the main products from the system is velvet which is a lot higher value/kg product and requires more energy to grow compared to meat which is why the kg DM/kg product is so much higher than the other sheep and beef models

** In this case study the current nitrogen leaching in the base was below the target of 12 so a scenario creating considering the options for increasing profitability but still maintaining this target

In this project the sample size of sheep and beef and deer farms is too small to draw any significant conclusions around the cost of reducing nitrogen leaching to the target of 12. The sample contained a range of intensities so that in effect there was one deer farm, two case studies running ewe breeding systems with some cattle (sheep:cattle ratio of 40:60 and 52:48), and the remaining case study predominantly a dairy grazing support block with some sheep carried.

This difference in systems run on the case studies selected makes it very difficult to come to any useful conclusions around mitigation tools to reduce nitrogen leaching on sheep and beef properties. There are a number of sheep, beef and deer systems which are not represented in this small sample including breeding cow, deer breeding systems, and intensive sheep, beef and deer fattening systems.

It appears that the main drivers of nitrogen leaching on sheep and beef and deer farms tend to be the number and class of livestock carried through the winter and nitrogen usage. Fertiliser nitrogen usage is significantly lower on sheep and beef farms compared to dairy farms with some sheep and beef farms not having applied nitrogen fertiliser in the last few years due to the low returns over this period.

The mitigation options which have been used in the above scenarios to reduce the nitrogen leaching are listed below:

- Reduction or complete removal of nitrogen fertiliser application: in the case studies which were applying nitrogen in the base this was nitrogen fertiliser was removed, reduced or shifted from application in the winter months to application in the spring period.
- In most cases the liveweight wintered was reduced through carrying fewer cattle through the winter period. In the case that this liveweight increased more sheep and fewer cattle were carried through the winter which

led to a drop in nitrogen leaching. In the ewe breeding systems reproductive efficiency was increased slightly due to ewes in better condition throughout the year and able to be flushed better during mating.

- Forage cropping was an option removed from some of the case studies
- Purchase and sale dates of livestock were altered usually reducing the number of livestock through the winter period.

There will potentially be a number of other mitigation tools available to sheep and beef and deer farms which have not been used in any of these case studies due to the small sample size and lack of variation in the systems selected.

Of the case studies used the cost of reducing the nitrogen leaching to reach the target of 12 kg N/ha was -$32.74 per kg reduced nitrogen leached with a range of -$7 to -$61.41/kg reduced N leached.

More research with a larger sample size is required before any conclusions can be drawn.

Appendix: Individual Case Study Information

Table of Contents

Appendix: Individual Farm Details

For the balance of the report, the case study farms are presented individually with the following detail around each one.

For all farms a Year in Year out model **(YIYO)** was derived, based on their history, and where they were at, at the present time.

In some of the tables the YIYO model is reported at $5.20/kg MS for 08-09 as well as the long term models at $4.55 and $5.50 looking forward, with standardized feed costs.

So as the different farms are presented, the following detail will be encountered in this order;

1. Overview of Assumptions made for base, scenario one, scenario delivered by NMP and scenario developed by Agfirst where necessary.

2. Table of business, physical and environmental KPI's from each farm, the scenarios, at long term milk prices.

3. SWOT analysis of the impact of the change, from the base model to the low nutrient leaching model

Summary of Assumptions

Below is a summary of assumptions that have been made to all of the dairy models unless otherwise stated:

- Feed costs based on $270/t PKE, $270/t DM maize silage delivered.
- 80-85% utilisation of feed that is fed in the paddock (this has been altered in some cases particularly where high proportions are fed in the winter period)
- 90% utilisation for feed that is fed either on a feed-pad or through an in-shed feed system
- Nitrogen fertiliser cost of $820/t applied
- MS/cow reported in the tables is based on peak cow numbers on 1st October
- For the purposes of asset values livestock were valued based on IRD values 2008/09 season which are as follows:
    - R1yr heifers $511/hd (Friesian) $434/hd (Jersey)
    - R2yr heifers $1083/hd (Friesian) $953/hd (Jersey)
    - MA cows $1312/hd (Friesian) $1243/hd (Jersey)
- Where stocking rate was reduced and cows were sold it was assumed that the lowest producers were sold at the cull cow rate of $500-600/cow. In cases where a large number of cows were sold (i.e.50-200) a higher price was assumed.
- % milksolids as a % liveweight based on liveweight at 1st December

Intensive Dairy Systems

DBM3

Base Model Assumptions - YIYO

- 255 Ha effective milking.
- 930 Cows (3.6 cows/ha); 25% Autumn Calving
- Production target of 500,000 kgMS/yr has been used in base model (1960 kg MS/ha; 538 kg MS/cow)
- Empty Spring Cows carried through June, July and culled mid July.
- 106 ha Effluent area
- 47 kg N/ha/yr applied as fertiliser over whole farm
- Good use of feedpad, cows stood off in wetter months.
- Nitrogen leaching at 44 kg N/ha/yr

Feed Bought in

- Maize Silage - 100T DM at $160/T DM (self grown at runoff)
- PKE - 1100T at $270/T as fed
- Mixed meals 800 T at $420/T

Scenario 1 (44 kg N/ha/yr to 38 kg N/ha/yr)

To lower N leaching from 44 to 38 kgN/ha, the following tools were used.

- DCD costs included, and pasture yield increased by 2% from April to Oct.
- N use reduced from 70kgN/ha to 47kgN/ha
- Effluent area increased from 106 to 141 ha
- 16 t less fertiliser applied as consequence of increased effluent area
- Physical performance remained very similar at 1957kgMS/ha and 510 kgMS/cow

For Scenario 2 (44 kg N/ha/yr to 36 kg N/ha/yr)

To Lower the N leaching from 44 to 36 kgN/ha Farmax

- DCD applied to whole farm
- N use maintained at 47kgN/ha
- 150t less meal feed
- 60% of cows wintered of for month June
- Physical performance could be maintained at 1963 kgMS/ha and 511 kgMS/cow

For Scenario 3: (44 kg N/ha/yr to 26 kg N/ha/yr)

To lower leaching from 44 to 26 kgN/ha required significant intervention including

- DCD applied to whole farm
- No nitrogen
- Cow numbers reduced to 650 and production down to 365,000 kgMS
- Imported feeds reduced from 2800 T DM to 1417 T DM
- 18 ha of the farm retired and planted in pines. Returns from the pines have been included at a net $625/ha per year from credits based on 30T/Ha/Yr at $25/T over a 25 year payment period.(30 T sequestered per year over a 30 yr growth cycle)
- Pine income is based on carbon sales only, there is no income included from the net income (income less cost of planting, maintenance and harvest) from harvest of the pines, it is assumed that this will be used to cover the carbon emission cost at harvest, and hence be cancelled out.
- Production is 1430kgMS/ha and 514 kgMS/cow.

Farm ID: DBM3 Milk Price $4.55/kg MS	Base Model 44 kg N/ha	Scenario 1 38 kg N/ha	Scenario 2 - 36kg N/ha Winter off	Scenario 3-26kg N/ha Winter on
Business - Profit				
Asset Value Total	10,742,663	10,742,663	10,742,663	9,424,298
Total Liabilities	4,000,000	4,000,000	4,000,000	3,035,000
Debt servicing at 8%	320,000	320,000	320,000	242,800
Any additional debt	0	30,000	30,000	30,000
Debt servicing total debt (if changed)	320,000	322,400	322,400	245,200
Total Operating Profit	447,209	426,786	437,326	438,927
GFI/Ha	12,043	12,074	12,058	8,814
Op Profit less debt servicing	127,209	106,786	117,326	196,127
Op Profit less new debt servicing	447,209	424,386	434,926	436,527
Operating Profit/Ha	1753	1673	1715	1718
ROA%	4.16%	3.97%	4.07%	4.66%
ROE %	1.89%	1.58%	1.74%	3.07%
Bought in Feeds T/DM/Ha	10.98	10.98	10.31	5.75
Pasture Harvested	**12.89**	**12.89**	**13.02**	**12.47**
Efficiency Measures				
MS/Ha	1965	1957	1963	1543
MS/Cow	512	510	511	514
Kg Dm/Kg MS	12.5	12.5	12.1	12.3
Kg MS/kg Cow lwt %	98	97	98	91
Risk				
Op Profit margin%	17%	17%	17%	24%
Total operating Expenses	$2,182,018	$2,210,499	$2,229,969	$1,467,835
Pasture as % of Total Consumed	54%	54%	56%	68%
Solvency				
Equity	$6,742,663	$6,742,663	$6,742,663	$6,389,298
Equity %	63%	63%	63%	68%
Environmental				
Change in Kg of N leached.		-6	-8	-18
Kg of N leached/Ha	44	38	36	26
Kg of N leached effluent area only.	41	36	34	28
$ change in op profit less new debt/change in kg N leached		-$ 14.92	-$ 6.02	-$ 2.33
$ change in Op Profit/change in Kg of N leached whole farm		-$ 13.33	-$ 4.75	-$ 1.94
Kg of P Runoff/Ha	0.6	0.6	0.6	0.7
N Conversion Efficiency %	37	39	41	49
g N leached/Kg MS	22.5	19.4	18.3	16.9
GHG/kg MS	7.8	7.5	7.3	7.2
Effl area/required %	132	174	174	166

Farm ID: DBM3 Milk Price $5.50/kg MS	Base Model 44 kg N/ha	Scenario 1 38 kg N/ha	Scenario 2-36kgN/ha (Winter off)	Scenario 3-26kgN/ha (Winter on)
Asset Value Total	10,742,663	10,742,663	10,742,663	9,424,298
Total Liabilities	4,000,000	4,000,000	4,000,000	3,035,000
Debt servicing at 8%	320,000	320,000	320,000	242,800
Any additional debt	0	30,000	30,000	30,000
Total Operating Profit	942,111	920,769	932,893	801,050
GFI/Ha	12,043	12,074	12,058	8,814
Op Profit less debt servicing	622,111	600,769	612,893	558,250
Op Profit less new debt servicing	942,111	918,369	930,493	798,650
Operating Profit/Ha	3694	3610	3658	3141
ROA%	8.77%	8.57%	8.68%	8.50%
ROE %	9.23%	8.91%	9.09%	8.74%
Bought in Feeds T/DM/Ha	10.98	10.98	10.31	5.75
Pasture Harvested	**12.89**	**12.89**	**13.02**	**12.47**
Efficiency Measures				
MS/Ha	1965	1957	1963	1543
MS/Cow	512	510	511	514
Kg Dm/Kg MS	12.5	12.5	12.1	12.3
Kg MS/kg Cow lwt %	98	97	98	91
Risk				
Op Profit margin%	31%	30%	30%	36%
Total operating Expenses	$2,182,018	$2,210,499	$2,229,969	$1,493,707
Pasture as % of Total Consumed	54%	54%	56%	68%
Solvency				
Equity	$6,742,663	$6,742,663	$6,742,663	$6,389,298
Equity %	63%	63%	63%	68%
Environmental				
Change in Kg of N leached.		-6	-8	-18
Kg of N leached/Ha	44	38	36	26
Kg of N leached effluent area only.	41	36	34	28
$ change in op profit less new debt/change in kg N leached		**-$ 15.52**	**-$ 5.70**	**-$ 31.26**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 14.00**	**-$ 4.50**	**-$ 30.72**
Kg of P Runoff/Ha	0.6	0.6	0.6	0.7
N Conversion Efficiency %	37	39	41	49
g N leached/Kg MS	22.4	19.4	18.3	16.9
GHG/kg MS	7.8	7.5	7.3	7.2
Effl area/required %	132	174	174	166

DBM3 SWOT – Base vs. 26kg N leach/ha/yr (No wintering off)

Strengths

- The farm is still viable with current equity levels.
- At the low payout level the farm is more profitable under the low N leaching scenario
- Green House gas emissions are reduced by 7.6% /kgMS and 27% in absolute terms
- Reduction in bought in feed reduces exposure to feed price volatility
- 7.0 % of the farm can be retired and planted in trees
- Per cow performance can be maintained
- Because the effluent area has increased and fertiliser input can be reduced the farm is less exposed to price fluctuations in this input category
- Bought in feed inputs reduced by 50% reducing exposure to pricing fluctuations

Weaknesses

- At payouts closer to the long term trend there is an impact of approx $140,000 in the profit after debt servicing
- More constrained in terms of ability to reinvest and grow the business
- Increased exposure to climatic risk with pasture now making up 68% of total feed, up from 54%

Opportunities

- Small ability to participate in carbon markets through the pines

Threats

- The pasture response to DCD is less than the 2% used in the model
- No carbon market exists for the pine plantation which will impact on profitability further.
- 1 staff member made redundant on the dairy unit
- Drop in land value and resale potential impacts on succession planning

AD1

Base Model Assumptions – YIYO

- 383 ha total, 270 ha effective milking.
- 870 Cows (3.2 cows/ha)
- 20% Autumn Calving; Empty Spring Cows carried through June, July and culled mid July.
- 50 ha effluent area;
- Good use of feedpad, cows stood off in wetter months, effluent from feed-pad collected in storage pond (3 month capacity) and spread at optimum times
- 370 cows grazed off-farm in winter
- Feed bought in adjusted for drought and difficult years of 07-08 and 08-09 to reflect more average year.
- Expected Production from 870 cows, is 371,655 kg MS. This is in line with levels previously achieved.
- Contract milker – changed to an industry standard, for a manager & includes imputed labour.
- Feed Prices adjusted to long term average, and feeds adjusted to show pasture harvest as per normal year for this farm.
- Hence $120K of feeds in costs not included.
- Animal Health, Electricity, Breeding, Weed and Pest, and Cropping, Fertiliser, Fuel, Admin, Rates, Insurance, as per clients accounts
- The Farmax expenses were used for N use, Labour, R & M, Vehicle Costs, depreciation.
- N leaching of 31 kg N/ha/yr

Feed Bought in – YIYO model

- Maize Silage 640T Dm at $270/T DM
- PKE 870T at $270/T as fed
- Maize Grain 179T at $350 T as fed.
- Tapioca or other at $400/T as fed

For Scenario 1: (leaching from 31 kg N/ha/yr to 26 kg N/ha/yr)

- DCD: cost included, and pasture yield increased by 2% from April to Oct.
- Total Feed Eaten still at 11.6 Tonne
- N use decreased on milking non effluent area from 139 kg to 120 kg/ha
- Reduced N application to new grass as emerging.

Scenario 1B (Agfirst Model): (leaching from 31 kg N/ha/yr to 24 kg N/ha/yr)

To lower N leaching from 31 kg/ha/yr to 24 kg/ha/yr the following tools were implemented

- 870 cows maintained
- 370 cows grazed off in winter
- Extra feed converted to milk
- Low levels of mineralisation achieved by use of 20 Ha of chicory in summer instead of turnip crops, the crop was direct drilled, and effluent from feed pad collected over winter period was used to achieve N source.
- DCD was used over the whole farm.
- Winter cows stand on feed pad for at least 5-6 hours in the autumn and winter months.
- N across the whole farm to 72 kg N/Ha
- Imported supplements - PKE 839 T; Maize Silage 619 T DM,
- Supplements grown on farm - Swedes 3 ha, Chicory 20 ha, 6 ha of 10 week maturity Turnips.

<u>For Scenario 2</u>: (leaching from 31 kg N/ha/yr to 26 kg N/ha/yr – no winter grazing off)

- 370 cows at home for winter – includes all heifers due to calve.
- Reduced N use on milking platform from 120kg N to 70 kg N/ha/yr this gives an overall use across whole farm of 84 kg/Ha/Yr
- Cow numbers reduced from 870 to 860
- Total MS production at 366,295 kg MS
- Feed imported increased to 827 T of PKE; 826 T DM Maize Silage; 181 T Maize Grain.
- Pasture Harvested 10.4 T DM/ha
- Dry Cows at home fed on Feed pad/wintering pad for 6-7 hours per day.
- Milking herd on wintering pad/feed pad for 5-6 hours per day.
- Feed pad flushed with water.
- Solids separated and stored 3 months and then spread onto turnips and kale crops.

Farm ID: AD1 Milk Price $4.55/kg MS	Base Model 31 kg N/ha/yr	Scenario 1 (NMP) 26 kg N/ha/yr	Scenario 1B 24 kg N/ha (winter grazing off)	Scenario 2 26 kg N/ha No winter grazing off
Business – Profit				
Asset Value Total	11,576,900	11,576,900	11,576,900	11,576,900
Total Liabilities	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing at 8%	176,000	176,000	176,000	176,000
Total assets if changed in model	11,576,900	11,576,900	11,576,900	11,576,900
Total Liabilities if changed in model	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing total debt (if changed)	176,000	176,000	176,000	176,000
Total Operating Profit	356,810	310,276	335,852	300,441
GFI/Ha	6,999	6,997	6,955	6,891
Op Profit less debt servicing	180,810	134,276	159,852	124,441
Operating Profit/Ha	1321	1149	1243	1112
ROA%	3.08%	2.68%	2.90%	2.60%
ROE %	1.93%	1.43%	1.70%	1.33%
Bought in Feeds T/DM/Ha	5.7	5.7	5.89	6.55
Calculated Pasture Harvested	**10.82**	**10.82**	**10.37**	**10.37**
Efficiency Measures				
MS/Ha	1377	1376	1367	1354
MS/Cow	492	492	489	491
Kg Dm/Kg MS	13.6	13.6	13.5	14.2
Kg MS/kg Cow lwt %	84.5	84.5	84	83
Risk				
Op Profit margin%	19%	16%	18%	16%
Total operating Expenses	$1,533,135	$1,578,950	$1,542,253	$1,560,396
Pasture as % of Total Consumed	59	61	61	57
Solvency				
Equity	$9,376,900	$9,376,900	$9,376,900	$9,376,900
Equity %	81%	81%	81%	81%
Environmental				
Change in Kg of N leached.		-5	-7	-5
Kg of N leached/Ha	31	26	24	26
Kg of N leached effluent area only.	43	38	39	38
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 34.40**	**-$ 11.14**	**-$ 41.80**
Kg of P Runoff/Ha	0.7	0.7	0.9	0.7
N Conversion Efficiency %	38	35	36	36
g N leached/Kg MS	22.5	18.9	17.6	19.2
GHG/kg MS	8	7.6	7.6	7.6
Effl area/required %	94	94	94	94

Farm ID: AD1 Milk Price $5.50/kg MS	Base Model 31 kg N/ha/yr	Scenario 1 26 kg N/ha/yr	Scenario 1B 24kgN/ha/yr Winter Grazing	Scenario 2 26 kgN/ha/yr No Winter Grazing
Business – Profit				
Asset Value Total	11,576,900	11,576,900	11,576,900	11,576,900
Total Liabilities	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing at 8%	176,000	176,000	176,000	176,000
Total assets if changed in model	11576900	11576900	11576900	11576900
Total Liabilities if changed in model	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing total debt (if changed)	176,000	176,000	176,000	176,000
Total Operating Profit	708,852	662,176	703,927	646,609
GFI/Ha	8,303	8,300	8,319	8,173
Op Profit less debt servicing	532,852	486,176	527,927	470,609
Operating Profit/Ha	2625	2452	2607	2394
ROA%	6.12%	5.72%	6.08%	5.59%
ROE %	5.68%	5.18%	5.63%	5.02%
Bought in Feeds T/DM/Ha	5.7	5.72	5.89	6.55
Calculated Pasture Harvested	**10.82**	**10.82**	**10.82**	**10.37**
Efficiency Measures				
MS/Ha	1377	1376	1367	1354
MS/Cow	492	492	489	491
Kg Dm/Kg MS	13.6	13.6	13.8	14.2
Kg MS/kg Cow lwt %	84.5	84.5	84.5	83.1
Risk				
Op Profit margin%	32%	30%	30%	29%
Total operating Expenses	$1,533,135	$1,578,950		$1,560,355
Pasture as % of Total Consumed	59	61	61	57
Solvency				
Equity	$9,376,900	$9,376,900	$9,376,900	$9,376,900
Equity %	81%	81%	81%	81%
Environmental				
Change in Kg of N leached.		-5	-7	-5
Kg of N leached/Ha	31	26	24	26
Kg of N leached effluent area only.	38	38	38	38
$ change in Op Profit/change in Kg of N leached whole farm		-$ 34.60	-$ 2.57	-$ 46.20
Kg of P Runoff/Ha	0.7	0.7	0.7	0.7
N Conversion Efficiency %	35	35	36	36
g N leached/Kg MS	22.5	18.9	17.6	19.2
GHG/kg MS	8	7.6	7.6	7.6
Effl area/required %	94	94	94	94

AD1 SWOT – Base vs. 26 kg N leach/ha/year (No wintering off)

Strengths

- Cow numbers are maintained and the system is generally similar.
- Productivity is very similar while reaching environmental targets
- At a high milk price, this farm is still strongly profitable, similar to that of the base year, and moderately profitable at a low milk price.
- The cost of change to a low impact system is marginal at milk prices above $5.50/kg MS.
- Efficiency of production is maintained while the environmental impact is minimized.
- More home grown feed is achieved via the use of a low environmental impact crop – changing from turnips to chicory (cultivation method changing from conventional to direct drilled), effluent collected from feed pad and spread over crop.
- No real up skilling is required, the system is similar.
- There is a lower reliance on nitrogen
- There is no real need for a change in cow numbers or cow type.
- There is better use of effluent in this system, allowing the farm to reduce costs further in terms of bought in fertilizer costs.

Weaknesses

- As a cost of compliance, this model now must rely on DCD, and this is a new cost, over the base model.
- There is a reliance on the crops yielding feed every year, however this was part of the system for the base model as well. Chicory is a change from turnips, and there will need to be some up skilling to be able to successfully manage this.
- Using direct drilling to establish the chicory may be a risk to the system if it is not well managed.

Opportunities

- Due to the nature of this business, the ability to adapt to a lower leaching scenario without major infrastructure costs allows this asset to become environmentally compliant without a high degree of expense.
- There may be opportunities for this business to market its product as environmentally compliant, should the market require it to do so.
- In time this may be linked to improved asset value, as environmental compliance is achievable, along with a profitable business model.(6% ROA at 24kg N leached)
- In the future, this low nutrient leaching model is also a low GHG emitter per kg of MS; this may position it well in the face of agriculture entering an ETS in the future.
- The relatively low cost of N mitigation, using the wintering off option may allow this farm to enter into a trading scheme for N in the future, while still operating a profitable business.

Threats

- This model will be vulnerable in the face of volatile climatic conditions; however the base model was just as vulnerable. There is no significant change to the dependence on bought in feeds.
- Threats of volatility in feed costs, however this was relevant to the base model as well.

AD2

Model Assumptions

- 149 eff Ha, 530 cows (3.5 cows/ha)
- 1491MS/ha; 435 kg MS/cow
- 540 kg cows
- 31% cows grazed off June; 16% July
- Young stock grazed off at weaning
- 148 kg N applied,
- 3.8 ha home grown maize (has effluent applied); 22 ha of home grown silage
- Effluent area 20 ha, good storage
- Feed pad, with some wintering done on it.
- 90 cows grazed off for 6 weeks.
- All costs were derived from 08-09 cash accounts, on a per cow basis.
- This was used, and the feed costs adjusted in long term comparison models.
- This farm is part of a larger farm, we have treated it as separate, and the 530 cows, are run on the 149 ha.
- Contract milkers operate the system, for the purposes of this project we have used a standard wage per cow.
- There is a lease block, the grazing and feed bought in is done at commercial rates, and the lease cost is not included.
- 55 kg N leached/ha/yr

Feed bought in - YIYO

- 440T DM Maize
- 460T PKE
- 20-30 t DM grass silage

Scenario 1: (leaching 55 kg N/ha/yr to 47 kg N/ha/yr)

- Effluent system extended to include an extra 10 ha, the pond was large enough with enough storage to accommodate this.
- Second irrigator, pipe and pump purchased, and capital expense of $52,000 was increased on the liabilities.
- Supplements imported: Maize silage 460 t DM; PKE 480 t DM; silage 30 t DM
- 2 Crops of silage cut off the effluent area and fed back to the cows.
- May and June N applications shifted from these high risk months to low risk months of the year with greater response rates.
- Applied same N all year, 148kg N/Ha/Yr applied, however not in sensitive months.
- DCD applied over whole farm (2 applications $94.50/application), growth rates increased 2% April-Oct.
- Young stock grazed off from weaning

Scenario 2: (leaching 55 kg N/ha/yr to 30 kg N/ha/yr)

- Cow numbers dropped from 530 to 450,
- Production dropped to 190000kg MS, 422 kg MS/cow
- 80% of cows wintered off (360 cows June and July)
- Maize silage fed on pad
- Brought in feed greatly reduced to 3.22T DM/ha/yr from 5.88 TDM/ha/yr.
- No DCD used.
- Young stock grazed off from weaning

Scenario 3: (leaching from 55 kg N/ha/yr to 26 kg N/ha/yr (using wintering off))

- 96% cows wintered off farm for 2 months.
- N fertiliser use dropped across whole farm to 50kgN/ha/yr.
- Cow numbers dropped down to 370 cows (540 kg Bodyweight)
- Maize imported 130T DM, 122T PKE, from system 5 to system 2-3. Total bought in feeds per ha 1.66 TDM/ha

Scenario 4: (leaching from 55 kg N/ha/yr to 26 kg N/ha/yr – No wintering off)

This property is situated on a high risk soil type which leads to significant changes required to reduce nitrogen leaching to 26 kg N/ha/yr without the use of grazing off.

- Bring all the wintered cows home from grazing (31% were wintered off June, and 16% were wintered off July)
- 100% of the cows were stood off on the wintering – feed pad with only 6 hours a day on grass.
- Solids trapped from the wintering pad, and help for 4 months, then applied to chicory block.
- Maize block and effluent block converted to 20 ha chicory – pastoral forage crop block, direct drilled, effluent applied, no other fertiliser applied to this area. Assumes that fertility will continue to build as this area will be grazed more regularly over the summer months due to the nature of the chicory crop.
- Stocking Rate dropped to 335 cows or 2.23 cows/ha down from 3.55 cows/ha (the lowest producers are sold from the herd).
- Production is 454 kg MS per cow and 144,424 kg MS/yr.
- PKE is removed, 282 T DM Maize silage imported
- Silage and hay made on the milking platform are fed on the feed pad.
- Cows spend approx 4-5 hours per day on the feed-pad all year.
- Nitrogen fertiliser has been dropped to an average of 50 kg N/ha over the whole farm

Farm ID: AD2 Milk Price $4.55/kg MS	Base Model	Scenario 1 48 kg N/ha	Scenario 2 34 kg N/ha	Scenario 3 26 kg N/ha	Scenario 4 26 kg N/ha No Winter Graze
Business – Profit					
Asset Value Total	6,385,760	6,385,760	6,385,760	6,385,760	5,780,320
Total Liabilities	957,864	957,864	957,864	957,864	356,424
Debt servicing at 8%	76,629	76,629	76,629	76,629	28,514
Any additional debt	0	52,000	52,000	52,000	52,000
Total assets if changed	6,385,760	6,437,760	6,437,760	6,437,760	5,832,320
Total Operating Profit	89,654	20,622	38,726	127,993	107,850
GFI/Ha	7,095	6,970	6,055	5,367	4,727
Op Profit less debt servicing	13024	-56007	-37903	51,363	79,336
Op Profit Less New Debt Servicing	89,654	16,462	34,566	123,833	103,690
Operating Profit/Ha	602	138	260	859	719
ROA%	1.40%	0.32%	0.61%	2.00%	1.87%
ROE %	0.24%	-1.03%	-0.70%	0.95%	1.46%
Bought in Feeds T/DM/Ha	5.9	6.19	4.41	1.47	1.9
Pasture Harvested	**12.66**	**12.26**	**10.96**	**10.93**	**10.22**
Efficiency Measures					
MS/Ha	1487	1460	1271	1126	987
MS/Cow	434	426	430	464	450
Kg Dm/Kg MS	14.4	14.6	13.0	11.2	13.3
Kg MS/kg Cow lwt %	87.1	85.6	88	94	89
Risk					
Op Profit margin%	8%	2%	4%	16%	15%
Total operating Expenses	$967,556	$1,017,951	$863,429	$671,718	$601,269
Pasture as % of Total Consumed	67.6	66	75	81	74
Solvency					
Equity	$5,427,896	$5,427,896	$5,427,896	$5,427,896	$5,423,896
Equity %	85%	84%	84%	84%	93%
Environmental					
Change in Kg of N leached.		-11	-24	-28	-27
Kg of N leached/Ha	54	43	30	26	26
Kg of N leached effluent area only.	51	30	26	23	30
$ change in Op profit less new debt/change in N leached		**-$ 44.36**	**-$ 15.30**	**$ 8.14**	**$ 3.47**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 42.18**	**-$ 14.25**	**$ 9.18**	**$ 4.33**
Kg of P Runoff/Ha	1.2	1.1	1.1	1.1	1.2
N Conversion Efficiency %	32	29	37	44	41
g N leached/Kg MS	36.3	29.5	23.6	23.1	26.3
GHG/kg MS	9	8.9	8.1	7.7	8.5
Effl area/required %	80	117	147	248	300

Farm ID: AD2 Milk price $5.50/kg MS	Base Model 54kgN/ha/yr	Scenario 1 43 kgN/ha/yr	Scenario 2 34 kgN/ha/yr	Scenario 3 26 kgN/ha/yr	Scenario 4-26kgN/ha/yr No Winter Graze
			Business – Profit		
Asset Value Total	6,385,760	6,385,760	6,385,760	6,385,760	5,780,320
Total Liabilities	957,864	957,864	957,864	957,864	356,424
Debt servicing at 8%	76,629	76,629	76,629	76,629	28,514
Any additional debt	0	52,000	52,000	52,000	52,000
Total assets if changed in model	6,385,760	6,437,760	6,437,760	6,437,760	5,832,320
Total Operating Profit	299,841	226,915	218,366	287,101	246,924
GFI/Ha	8,506	8,355	7,260	6,435	5,654
Op Profit less debt servicing	223,211	150,285	141,736	210,471	218,410
Op Profit Less New Debt Servicing	299,841	222,755	214,206	282,941	242,764
Operating Profit/Ha	2012	1523	1466	1927	1646
ROA%	4.70%	3.55%	3.42%	4.50%	4.27%
ROE %	4.11%	2.77%	2.61%	3.88%	4.03%
Bought in Feeds T/DM/Ha	5.9	5.9	4.41	1.47	1.9
Pasture Harvested	**12.66**	**12.66**	**10.96**	**10.93**	**10.22**
			Efficiency Measures		
MS/Ha	1487	1460	1271	1126	987
MS/Cow	434	426	430	464	450
Kg Dm/Kg MS	14.4	14.6	13.0	11.2	13.3
Kg MS/kg Cow lwt %	87.1	85.6	88	94	89
			Risk		
Op Profit margin%	24%	18%	20%	30%	29%
Total operating Expenses	$967,556	$1,017,951	$863,439	$671,718	$601,269
Pasture as % of Total Consumed	67.6	66	75	81	74
			Solvency		
Equity	$5,427,896	$5,427,896	$5,427,896	$5,427,896	$5,423,896
Equity %	85%	84%	84%	84%	93%
			Environmental		
Change in Kg of N leached.		-11	-24	-28	-28
Kg of N leached/Ha	54	43	30	26	26
Kg of N leached effluent area only.	51	30	26	23	30
$ change in Op profit less new debt/change in N leached		**-$ 46.72**	**-$ 23.79**	**-$ 4.02**	**-$ 13.59**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 44.45**	**-$ 22.75**	**-$ 3.04**	**-$ 13.07**
Kg of P Runoff/Ha	1.2	1.1	1.1	1.1	1.2
N Conversion Efficiency %	32	29	37	44	41
g N leached/Kg MS	36.3	29.5	23.6	23.1	26.3
GHG/kg MS	9	8.9	8.1	7.7	8.5
Effl area/required %	80	117	147	248	300

AD2 SWOT –Base vs. low nutrient leaching option (No wintering off)

Strengths

- This has involved a shift from a high input system to a lower input system to become environmentally compliant. As a result, this has lowered the risk profile of the business as it has less dependence on bought in feeds.
- Productivity is similar per cow, yet per ha it is around 15% lower. Stocking rate is lower, from 3.55 cows/ha to 2.5 cows/ha.
- There are fewer cows, and this may result in lower labour requirements. This could be stated as a lower risk for the system.
- This farm system may be more resilient should there be more volatile weather conditions. This leads to a lower overall risk profile for the business.
- At a lower milk price, this farm system is more profitable than the present high intensity system in place. This can be achieved, while greatly improving environmental performance (reduced leaching by 25 kg N).
- There is a net benefit to the system of $3.47/kg of Nitrogen not leached
- This system is now both environmentally compliant, and still profitable at a low milk price.
- The ROA lifts 40% above the base model at $4.55/kg MS milk price, so at lower milk prices this could be regarded as a more resilient system.
- This system will enhance its long term sustainability, and will likely preserve its long term asset values.
- This low nutrient leaching model has only 85% of the GHG losses per kg of product when compared with the base model.
- No DCD was required in this model, so costs of compliance in this respect were not significant

Weaknesses

- There will need to be improved pasture management within the system due to the lower stocking rate. There may be a more long term shift to more forage growth and conservation of feed on farm. This could introduce more risk if it is not well managed.
- To achieve high per cow production, the cows will have to be well managed at the lower stocking rate, with tight feedback systems within the management system to enhance high productivity.
- There may be pressure to more carefully select more productive cows.
- There is infrastructure on the farm developed for 530 cows; this may be underutilized with a drop to 330 cows.
- At higher long term average milk prices, (>$5.50) this scenario is slightly less profitable than the base model. (ROA at 4.27% vs. 4.70% for base model)

Opportunities

- In the light of long term asset values, and exit strategies in the case of a sale for example, this farm is environmentally compliant, and enjoys improved profitability when compared to that at the base level. This will enhance its market value in the long term.
- This farm has a lower emissions profile as GHG drops from 9kg to 7.7 kg C02/kg MS at this lower intensity, which may be an opportunity should agriculture be included in an ETS at any time in the future.
- This farm has a lower impact on the wider environment. It may use this as an opportunity, to assist with marketing its product should the markets demand this in the future.

Threats

- Potential pasture under utilization of the infrastructure on the property via lower cow numbers

Medium Intensity Dairy Models

JA01 Base

Model Base Assumptions – YIYO

- 100 ha, 159,000kgMS
- 340 cows
- 52 ha runoff, used for young stock and supplements
- 21% of cows wintered off farm (not at runoff) for 2 months
- 90% irrigated
- 150 kg N/ha/yr fertiliser applied
- 13 ha effluent area
- N leaching at 65kgN/ha

Supplements imported:

- 79t DM grass silage (purchased)
- 112t DM Grass silage (transferred from runoff)
- 209t PKE

<u>Scenario One –</u> (Leaching from 65 kg N/ha/yr to 53 kg N/ha/yr)

- No change in cow numbers
- Imported supplements:
    - 79t DM grass silage (purchased)
    - 112t DM Grass silage (transferred from runoff)
    - 209t PKE
    - Maize silage 40t DM
- Use DCD in April instead of urea: Eliminated April application of urea from Farmax (2500kgN); Increased pasture growth from April –Oct by 2%; Added in a cost in expenses of $94.50/ha x 100hax2 = $18,900
- Only adjustment in fertiliser spend is less urea, plus DCD as above
- Overseer reports state N usage reduced by 37kgN/ha, or 3700kgN total (8 t urea). (note overseer reports show a reduction in winter n use from 43 to 5kg/ha)
- Farmax reports - reduced 2500kgN by DCD use in April, and 1200kg N in July (half of original application) through use of (maize 39tDM @ $0.27/kg). 39t was as per NMP recommendation
- Expand effluent area from 13 to 16ha. $3000 to account for increase in capital cost of effluent expansion.

<u>Scenario Two –</u> (leaching from 65 kg N/ha/yr to 28 kg N/ha/yr)

- Expand effluent area from 13 to 25ha. Capital cost of effluent expansion = $12k.
- Cow numbers reduced from 340 to 300. Reduced capital investment by 40 x $1200+ 22 x $500 = $59,000
- Production down from 159,000 kg MS/yr to 144,000 kg MS/yr
- Imported supplements:
    - 77t DM Grass silage (transferred from runoff)
    - 47t DM Hay (transferred from runoff)
    - Maize grain 181 t

- Additional pasture silage & hay made at runoff (base was 112t DM transferred to home block). Now making 77+38 t DM silage and 210 big bales of hay (47tDM). Left the 38tDM grass silage at runoff, rest transferred to milking block. Have not adjusted costs at this stage (should be similar)

- Replacements reduced from 112 to 90.
- N use reduced from 8 applications (186 kgN/ha/yr) to 2 (50kg/ha). Overseer adjusted to reflect this
- Note that base overseer budget introduced 94kgN/ha/yr from imported supplement. This scenario introduces 53kgN/ha.
- No DCD used, as there was NO change in N leaching if using DCD in overseer.
- Used in shed feeders (were being installed in June 09 anyway). Using maize grain in the in-shed feeders rather than PKE. Cost is higher ($380/t, but ME is 12, and reduces N leaching). Account for capital cost of $40k for feed system.
- Increased winter grazing off from 70 animals (21%) of herd to 100% of herd.
- Switched from using PKE to maize grain
- Planted a chicory crop for summer use. Cost = $900/ha direct drill, plus $600/ha regrassing. Shown in forage costs.

<u>Scenario Three</u> – (leaching from 65kg N/ha/yr to 26 kg N/ha/yr) (as suggested in NMP)

- Production reduced from 159000 kg MS/yr to 93000 kg MS/yr.
- As a consequence of drop in milk production capital cost of shares reduced by 66000x $5 = $330000.
- Reduced cow numbers to 190 (from 340). Therefore reduced capital investment by 150 x $1200+ 62 x $500 = $211000.
- Reduced replacements to 50
- Rather than wintering cows with an external grazier they have been wintered on the runoff (40% of herd have been wintered off for 2 months)
- Expand effluent area from 13ha to 25ha. Capital cost of effluent expansion = $12,000.
- Increased silage made on runoff by 25% - extra costs included. Increased silage at runoff is not needed at milking block, therefore sold 100tDM @ $0.20/kg standing. Hay not needed either, therefore 179 bales sold at $60/bale. Therefore $20,000 + $10,740 = $30,740 extra income.
- 4 crops of silage made on home farm. Not all of this is required on the milking platform, therefore surplus silage is sold off farm. (58t DM grass silage)
- No nitrogen used at all.
- No DCD used as no response noted in Overseer N leaching
- Reduced wages cost from $60,000 to $5,000 (one labour unit no longer required due to drop in intensity)

<u>Scenario Four</u> – (leaching from 65 kg N/ha/yr to 26 kg N/ha/yr - no winter grazing) (Developed by Agfirst)

- 250 Friesian cows, 550kgMS/cow
- Build a feed pad; cows are stood on wintering pad on average 19 hrs/day in June & July. Effluent captured, stored for 2 months, and then spread onto main block. Capital cost of $130,000 for wintering pad, and $20,000 for slurry tanker to assist in spreading effluent
- Effluent area expanded to 25ha. Capital cost of $12,000
- Used in-shed feeders (were being installed in June 09 anyway). Maize grain fed in the in-shed feeders rather than PKE. Cost of maize grain is higher ($380/t compared to $270/t for PKE, but ME of maize grain is 12, and results in lower N leaching compared to feeding PKE due to lower N content of feed). Account for capital cost of $40,000 for feed system.
- Total capital invested = $40,000 +12,000+$150,000 = $202,000.
- Reduction in cow numbers, =90 cows x $1200 and 30 replacements x $500 = $123000
- Share reduction = $22000 x $5/share = $110,000. Thus total reduction in capital = $12300 + $110000 = $233000.

- Rubber matting on the feed pad has been allowed for to enhance cow comfort during long periods of standing off. These cows spend 5 hours on pasture only during the winter months. (Total of 19 hours/day off pasture). This has incurred a net capital expenditure of $50,000 and it was assumed that this was borrowed. Total asset value has not been increased.
- Supplement reduced to 125 t maize grain, 125 t DM maize silage, + 50t DM hay from runoff – to improve N conversion efficiency
- Reduced replacement numbers down to 82 from 112 (kept same %)
- DCD over whole farm - $18,900 (2 applications)
- 25kg N/ha on main block
- 50t DM silage bought from runoff
- 50t DM hay bought from runoff

Runoff

(Not included in nutrient budget but modelled to ensure able to cope with changes to system)

- 82 rep heifers run.
- Increased liveweight to reflect change in breed to Friesian
- Increased quantity of silage and hay made. Increase cost of silage by 25%. Increased runoff lease cost figure (in home farm Farmax file) by 25%, from $18,150 to $22,687
- 50t DM hay & 50t DM grass silage transferred to home farm. This leaves a surplus of 20t DM silage. Sold this off farm @ $.20/kg DM (i.e. $5,400).

Farm ID: JA01 Milk Price: $4.55/kg MS	Base Model 65 kg N/ha/yr	Scenario 1 53 kg N/ha/yr	Scenario 2 28 kg N/ha/yr	Scenario 3 (NMP) 26 kg N/ha/yr (winter grazing)	Scenario 4 - 26kgN/ha/yr (No winter grazing)
Business – Profit					
Asset Value Total	7,485,200	7,485,200	7,485,200	7,485,200	7,485,200
Total Liabilities	2,501,000	2,501,000	2,501,000	2,501,000	2,501,000
Debt servicing at 8%	200,080	200,080	200,080	200,080	200,080
Any additional debt	0	3000	-7000		50000
Debt servicing total debt (if changed)	200,080	200,320	199,520	157,760	204,080
Total Operating Profit	163,241	131,760	89,958	103,597	128,550
GFI/Ha	7,704	7,608	7,060	4,626	6,643
Op Profit less debt servicing	-36839	-68320	-110122	-96483	-71530
Operating Profit/Ha	1632	1318	900	1036	1285
ROA%	2.18%	1.76%	1.20%	1.38%	1.72%
ROE %	-0.74%	-1.37%	-2.21%	-1.94%	-1.44%
Bought in Feeds T/DM/Ha	4.01	4.4	2.86	0	3.52
Pasture Harvested	**12.48**	**12.04**	**11.06**	**8.94**	**10.46**
Efficiency Measures					
MS/Ha	1577	1556	1454	935	1355
MS/Cow	472	466	490	503	551
Kg Dm/Kg MS	11.9	12.1	10.5	9.6	11.2
Kg MS/kg Cow lwt %	105	104	107	108.6	106.3
Risk					
Op Profit margin%	21%	17%	13%	22%	19%
Total operating Expenses	$607,138	$629,070	$616,041	$358,966	$535,758
Pasture as % of Total Consumed	76%	75%	82%	100%	75%
Solvency					
Equity	$4,984,200	$4,984,200	$4,984,200	$4,984,200	$4,984,200
Equity %	67%	67%	67%	72%	66%
Environmental					
Change in Kg of N leached.		-12	-37	-38	-39
Kg of N leached/Ha	65	53	28	27	26
Kg of N leached effluent area only.	77	60	28	31	30
$ change in op profit less new debt serv/Change in kg of N leached		**-$ 26.43**	**-$ 19.65**	**-$ 15.70**	**-$ 9.92**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 26.17**	**-$ 19.78**	**-$ 15.68**	**-$ 8.90**
Kg of P Runoff/Ha	1.4	1.5	1.5	1.4	1.4
N Conversion Efficiency %	30	32	50	37	49
g N leached/Kg MS	41.2	34.1	19.3	28.9	19.2
GHG/kg MS	8.5	8.2	6.8	9.1	7.4
Effl area/required %	66%	84%	163%	163%	149%

Farm ID: JA01 Milk Price $5.50/kg MS	Base Model 65 kg N/ha/yr	Scenario 1 53 kg N/ha/yr	Scenario 2 28 kg N/ha/yr	Scenario 3 (NMP) (winter off) 26kg N/ha/yr	Scenario 4 - 26kgN/ha/yr (No winter grazing)
Business – Profit					
Asset Value Total	7,485,200	7,485,200	7,485,200	7,485,200	7,485,200
Total Liabilities	2,501,000	2,501,000	2,501,000	2,501,000	2,501,000
Debt servicing at 8%	200,080	200,080	200,080	200,080	200,080
Any additional debt		3000	-7000		50000
Debt servicing total debt (if changed)	200,080	200,320	199,520	157,760	204,080
Total Operating Profit	312,967	279,386	228,050	192,458	257,178
GFI/Ha	9,201	9,085	8,441	5,514	7,929
Op Profit less debt servicing	112,887	79,306	27,970	192,458	57,098
Operating Profit/Ha	$3130	$2794	$2281	$1925	$2572
ROA%	4.18%	3.73%	3.05%	2.57%	3.44%
ROE %	2.26%	1.59%	0.56%	3.86%	1.15%
Bought in Feeds T/DM/Ha	4.01	4.4	2.86	0	3.52
Pasture Harvested	**12.48**	**12.04**	**11.06**	**8.94**	**10.46**
Efficiency Measures					
MS/Ha	1577	1556	1454	935	1355
MS/Cow	472	466	490	503	551
Kg Dm/Kg MS	11.9	12.1	10.5	9.6	11.2
Kg MS/kg Cow lwt %	105	104	107	108.6	106.3
Risk					
Op Profit margin%	34%	31%	27%	35%	32%
Total operating Expenses	$607,138	$629,070	$616,041	$358,966	$535,758
Pasture as % of Total Consumed	76%	75%	82%	100%	75%
Solvency					
Equity	$4,984,200	$4,984,200	$4,984,200	$4,984,200	$4,984,200
Equity %	67%	67%	67%	72%	66%
Environmental					
Change in Kg of N leached.		-12	-37	-38	-39
Kg of N leached/Ha	65	53	28	27	26
Kg of N leached effluent area only.	77	60	28	31	30
$ change in op profit less new debt serv/Change in kg of N leached		**-$ 28.18**	**-$ 22.80**	**-$ 31.71**	**-$ 15.33**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 28.00**	**-$ 22.95**	**-$ 31.71**	**-$ 14.31**
Kg of P Runoff/Ha	1.4	1.5	1.5	1.4	1.4
N Conversion Efficiency %	30	32	50	37	49
g N leached/Kg MS	41.2	34.1	19.3	28.9	19.2
GHG/kg MS	8.5	8.2	6.8	9.1	7.4
Effl area/required %	66%	84%	163%	163%	149%

JA1 SWOT – Base vs. low leaching 26 kg N/ha/yr (no wintering off)

Strengths

- Lower N leaching – meets targeted level of 26 kg N/ha/yr.
- This model makes better use of the effluent being produced by spreading over a larger area.
- Use of a chicory crop will help to reduce N leaching.
- Fewer cows, but similar production means greater per cow efficiency
- Less pressure on the cow shed (fewer rows), which is currently at peak capacity
- Lower capital required due to the lower cow numbers
- Lower reliance on nitrogen
- Lower intensity system should mean lower time requirements on current labour units. (Probably not enough to reduce labour units but lead to lower work hours)
- A lower stocking rate may mean less risk if there is a major feed deficit due to drought or poor winter pasture growth.

Weaknesses

- A lower stocking rate increases the risk of poor grazing management, leading to poorer pasture quality and thus reduced production.
- Reduced nitrogen applications may affect pasture growth to a greater extent than the model predicts.
- Lower financial profitability 3.44% ROA vs. 4.18% ROA in the base model
- Direct drilling chicory crops may increase the risk of a reduction in yield if it is not carefully managed
- There may be a gap in the knowledge in terms of growing a successful chicory crop and pests and weeds that reduce yield
- Capital investment required for both in-shed feeding system and extension of effluent area.

Opportunities

- Dropping the stocking rate gives the opportunity to select the best cows from the current herd and sell the worst cows.
- Opportunity to increase the profitability of the system whilst reducing the impact on the environment.
- If regulation is introduced, having a system which is profitable and can be run under a low leaching system may lead to an increase in the value of the land.

Threats

- Under the proposed system of cows being wintered on, there may be issues around animal welfare of animals standing on pads for significant periods over the winter. This model assumed cows standing on the pad and loafing pad for a total of 19 hours per day in the winter months.
- Threat of volatile feed prices for feeds that are being brought in.
- Not fully utilising the money invested in the land, buildings and infrastructure in terms of running the most profitable system if the payout increases.

NW1

Assumptions for Base model – YIYO

- Effective area 135ha
- 385 cows (2.9 cows//ha)
- Total Production 151,000 kg MS
- Young stock grazed off from weaning
- 12 ha turnips planted, conventional cultivation used
- Effluent sprayed from sump
- 104 kg N/ha applied as fertiliser
- No DCD applied
- Total labour cost of $105,000 which equates to $19.42/hour average across all people working on the property
- Nitrogen leaching of 33 kg N/ha/yr
- Assume land value of $32000/ha
- Assume debt levels at 35% of assets

Supplements imported

- PKE – 195 t
- Baleage (180 kg DM/bale) – 30 t DM
- Baleage - (from the runoff, 180 kg DM/bale) 13 t DM
- Triticale - (from the runoff) 270 t DM
- 285 cows grazed off 7 weeks over the winter months

The runoff has been treated as a separate entity and any costs associated to the runoff have been removed from the accounts. Any feed transfers and grazing off have been included in the financial analysis at commercial rates. The value of the land has also been excluded from the analysis

Scenario 1 – leaching from 33 kg N/ha/yr to 27kg N/ha/yr

- Total Production dropped from 151,000kg MS/yr to 146,949 kg MS/yr
- Cultivation method of turnips changed to minimum till (saves $300/ha cost)
- N fertiliser dropped from 104 kg N/ha/yr over whole farm to 97 kg N/ha/yr
- DCD applied over whole farm. Growth rates increased by 2% from April through to October (inclusive)
- PKE dropped from 195 t to 111 t
- Triticale(runoff) dropped from 270 t DM to 248 t DM

Scenario 2 – leaching from 33 kg N/ha/yr to 26 kg N/ha/yr

- Peak cows milked dropped from 377 to 344
- Total Production dropped from 151,001 kg MS/yr to 133,290 kg MS/yr
- Cultivation method of turnips changed to direct drilling (saves $300/ha)
- N fertiliser dropped from an average of 104 kg N/ha/yr to 68 kg N/ha/yr
- PKE dropped from 195 t to 110 t
- Triticale from runoff dropped from 270 t DM to 240 t DM
- Cows grazed off dropped from 285 cows off for 7 weeks to 263 off for 7 weeks
- DCD applied over whole farm. Growth rates increased by 2% from April through to October (inclusive)

<u>Scenario 3 –</u> leaching from 33 kg N/ha/yr to 26 kg N/ha/yr (no wintering off)

- Peak cows milked dropped from 377 to 365
- Total Production increased from 151,001 kg MS/yr to 152,919 kg MS/yr
- Crop changed from 12 ha turnips to 12 ha chicory using minimum till as the cultivation method
- Feed-pad built at a cost of $159,000
- Holding pond to store effluent from dairy and feedpad for 3 months installed. Cost $45,000 including pond liner
- N fertiliser reduced from an average of 104 kg N/ha to 84 kg N/ha
- PKE imported increase slightly from 195 t to 200 t
- No winter grazing
- DCD applied over whole farm. Growth rates increased by 2% from April through to October (inclusive)

Farm ID: NW1 Milk Price $4.55/kg MS	Base Model 33 kg N/ha/yr	Scenario 1 27 kgN/ha/yr	Scenario 2 26 kgN/ha/yr	Scenario 3 – 26 kg N/ha/yr (no winter off)
Business – Profit				
Asset Value Total	4,700,562	4,700,562	4,700,562	4,700,562
Total Liabilities	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing at 8%	176000	176000	176000	176000
Any additional debt	0	0	0	183000
Debt servicing total debt (if changed)	176,000	174,336	169,393	190,640
Total Op Profit less new debt servicing	$27,281	$15,687	$23,275	$51,713
Total Operating Profit	$27,281	$15,687	$23,275	$66,353
GFI/Ha	$5,495	$5,348	$4,901	$5,541
Op Profit less debt servicing	- 148,719	- 160,313	- 2,725	- 109,647
Operating Profit/Ha	$202	$116	$220	$492
ROA%	0.58%	0.33%	0.50%	1.41%
ROE %	-5.95%	-6.41%	-6.11%	-4.73%
Bought in Feeds T/DM/Ha	3.6	2.89	1.92	3.68
Pasture Harvested	**9.84**	**9.77**	**9.74**	**10.15**
Efficiency Measures				
MS/Ha	1118	1085	987	1133
MS/Cow	405	393	387	419
Kg Dm/Kg MS	12.0	11.7	11.8	12.2
Kg MS/kg Cow lwt %	75.3	73.8	71.3	78.9
Risk				
Op Profit margin%	4%	2%	4%	9%
Total operating Expenses	$714,491	$706,260	$638,377	$747,990
Pasture as % of Total Consumed	74.9	75.1	79.2	70.1
Solvency				
Equity	$2,500,562	$2,500,600	$2,500,562	$2,317,562
Equity %	53%	53%	54%	49%
Environmental				
Change in Kg of N leached.		-7	-8	-8
Kg of N leached/Ha	34	27	26	26
Kg of N leached effluent area only.	37	29	30	35
$ change in op profit less new debt/change in kg of N leached		**-$ 12.27**	**-$ 3.71**	**$ 22.62**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 12.29**	**$ 2.25**	**$ 36.25**
Kg of P Runoff/Ha	0.8	0.8	0.8	0.8
N Conversion Efficiency %	33	32	37	34
g N leached/Kg MS	30.4	24.9	26.3	22.9
GHG/kg MS	8.5	8.4	8.5	8.5
Effl area/required %	109%	109%	109%	256%

Farm ID: NW1 Milk Price $5.50/kg MS	Base Model 33 kg N/ha/yr	Scenario 1 27 kgN/ha/yr	Scenario 2 26 kgN/ha/yr	Scenario 3 – 26 kg N/ha/yr (no winter off)
Business – Profit				
Asset Value Total	4,700,562	4,700,562	4,700,562	4,700,562
Total Liabilities	2,200,000	2,200,000	2,200,000	2,200,000
Debt servicing at 8%	176,000	176,000	176,000	176,000
Any additional debt	0	0	0	183000
Debt servicing total debt (if changed)	176,000	174,336	169,393	190,640
Total Op Profit less new debt servicing	169,407	153,642	148,660	195,564
Total Operating Profit	169,407	153,642	148,660	210,204
GFI/Ha	6,547	6,370	5,830	6,606
Op Profit less debt servicing	-$ 6,593	-$ 22,358	-$ 27,340	$ 34,204
Operating Profit/Ha	1255	1138	1101	1557
ROA%	3.60%	3.27%	3.16%	4.47%
ROE %	-0.26%	-0.89%	-1.09%	1.48%
Bought in Feeds T/DM/Ha	3.6	2.89	1.92	3.68
Pasture Harvested	**9.84**	**9.77**	**9.74**	**10.15**
Efficiency Measures				
MS/Ha	1118	1085	987	1133
MS/Cow	405	393	387	419
Kg Dm/Kg MS	12.0	11.7	11.8	12.2
Kg MS/kg Cow lwt %	75.3	73.8	71.3	78.9
Risk				
Op Profit margin%	19%	18%	19%	24%
Total operating Expenses	$714,491	$706,260	$638,377	681637
Pasture as % of Total Consumed	74.9	75.1	79.2	70.1
Solvency				
Equity	$2,500,562	$2,500,600	$2,500,562	$2,317,562
Equity %	53%	53%	54%	49%
Environmental				
Change in Kg of N leached.		-7	-8	-8
Kg of N leached/Ha	34	27	26	26
Kg of N leached effluent area only.	37	29	30	35
$ change in op profit less new debt/change in kg of N leached		**-$ 16.68**	**-$ 19.21**	**$ 12.07**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 16.71**	**-$ 19.25**	**$ 37.75**
Kg of P Runoff/Ha	0.8	0.8	0.8	0.8
N Conversion Efficiency %	33	32	37	34
g N leached/Kg MS	30.4	24.9	26.3	22.9
GHG/kg MS	8.5	8.4	8.5	8.5
Effl area/required %	109%	109%	109%	256%

NW1 SWOT – Base vs. low leaching at 26kg N/ha/yr (no wintering off)

Strengths

- This model is only dependant on feed from the runoff and therefore is no longer at risk of volatile feed prices.
- This model is more profitable than the base model.
- Lower reliance on nitrogen.
- Chicory planted instead of turnips which has greater resilience during dry summer.
- Better use of nutrients in effluent through installing a holding pond and spraying the effluent at optimum times.
- Effluent is also used to fertilise the chicory which reduces the fertiliser costs.
- Lower intensity system should mean lower time requirements on current labour units. Probably not enough to reduce labour units but lead to lower work hours.
- At $4.55/kg MS and $5.50/kg MS payout reducing the nitrogen leaching as in this scenario increases the profitability of the system.

Weaknesses

- Direct drilling crops can cause a reduction in yield if it is not carefully managed
- The lower percentage of imported feed levels increases the risk of drought type effects. This could be of particular concern due to the predictions of climate change bringing increased incidences of extreme weather events in particular drought and floods.
- The model assumes current labour units have the skills to manage the pasture covers throughout the season under a slightly lower stocking rate system.
- Higher capital required to put feedpad in and upgrade effluent system
- Carrying all the cows through the winter months will increase the labour required during this time
- Careful management will be needed during the winter to ensure that the cows are not pugging the soils and causing soil structure damage

Opportunities

- Opportunity to increase the profitability of the system whilst reducing the impact on the environment in a low payout season.
- Opportunity to become a leader and showcase in the agriculture industry. To minimise impact on the environment and become more profitable
- Having a system which is profitable and can be run under a low leaching system may lead to an increase in the value of the land.

Threats

- Not fully utilising the investment in the land, buildings and infrastructure in terms of running the most profitable system if the payout increases.
- Variation in reduction N leaching and additional growth rates due to the application DCD from season to season depending on rainfall etc.

NW2

Base Model Assumptions – YIYO model

- Effective area 275 ha
- Peak cows milked670
- Total Production 220033 kg MS/yr; 800 kg MS/ha
- Young stock grazed off at 9 months
- 15 ha turnips and 15 ha swedes grown using conventional cultivation
- No effluent holding pond; effluent spread from sump
- Average of 230 kg N/ha N fertiliser applied
- Farm is new conversion from forestry and therefore considered a developing farm in Overseer
- Farm has in-shed feeder system
- Currently property has a sharemilker. This has been changed to an Owner Operator and costs standardised to enable comparisons with other farms in the project. Debt level of 35% has been assumed.
- Land value of $28,000/ha used based on recent sales of similar land in the area
- Nitrogen leaching estimated by Overseer at 44 kg N/ha/yr

Feed imported

- 440 t PKE
- 208 t DM pasture silage

The plan for the 2009/10 season is being used as the base year as this is a forestry conversion property. The 08/09 season was the first year of production and the pasture covers going into the season were at about 2800 kg DM/ha and the property was also able to use the neighbouring farm (which was in the conversion process) during the summer to graze the milkers on. This bought in an additional approximately 350t DM of feed into the system. This will not be available on a year in/year out system.

Scenario 1 – leaching from 44 kg N/ha/yr to 25 kg N/ha/yr

- Peak cows numbers milked dropped from 670 to 610
- Total Production increased maintained around 220033 kg MS; 800 kg MS/ha
- Young stock grazed off at weaning as opposed to 9 months
- Turnips and Swedes removed and replaced with 30 ha chicory to be followed by an annual both of which are direct drilled. Assumed cost of $926/ha
- Effluent holding pond installed and effluent spread at optimum times. Capital cost $50,000
- N fertiliser dropped from an average of 230 kg N/ha to 145 kg N/ha. All winter applications of N removed first or moved to lower risk times of the year when responses are greater.
- PKE imported dropped from 440 t PKE to 158 t PKE
- Pasture silage imported dropped from 208 t DM to 42 t DM
- All cows are grazed off for 8 weeks over the winter period

Scenario 2 – leaching from 44 kg N/ha/r to 26 kg N/ha/yr (no wintering off)

- Peak cows milked dropped from 670 to 600
- Total Production increased slightly from 220,033 kg MS; 800 kg MS/ha to 225,668 kg MS; 821 kg MS/ha
- Young stock grazed off at weaning
- Turnips and Swedes removed and replaced with 30 ha chicory to be followed by an annual both of which are direct drilled. Assumed cost of $926/ha

- Effluent holding pond installed and effluent spread at optimum times. Capital cost $50,000
- N fertiliser dropped from an average of 230 kg N/ha to 167 kg N/ha. All winter applications of N removed first or moved to lower risk times of the year when responses are greater.
- PKE imported increased from 440 t PKE to 495 t PKE
- Pasture silage maintained at 208 t DM
- No cows grazed off
- DCD applied to whole farm; growth rates increased 2% in the months of April to October

Farm ID: NW2 Milk Price: $4.55/kg MS	Base Model 44 kg N/ha/yr	Scenario 1 25 kg N/ha/yr	Scenario 2 -26 kgN/ha/yr (No Winter grazing)
Business – Profit			
Asset Value Total	8,400,000	8,400,000	8,400,000
Total Liabilities	2,940,000	2,940,000	2,940,000
Debt servicing at 8%	235,200	235,200	235,200
Any additional debt	0	8000	8000
Operating Profit less new debt servicing	49,851	183,528	79,144
Total Operating Profit	49,851	184,168	79,784
GFI/Ha	3,852	4,016	3,976
Op Profit less debt servicing	-185349	-51032	-155416
Operating Profit/Ha	181	670	290
ROA%	0.59%	2.19%	0.95%
ROE %	-3.39%	-0.94%	-2.85%
Bought in Feeds T/DM/Ha	2.21	0.68	2.38
Pasture Harvested	**9.83**	**9.32**	**9.46**
Efficiency Measures			
MS/Ha	800	836	821
MS/Cow	328	377	376
Kg Dm/Kg MS	15.0	12.0	14.4
Kg MS/kg Cow lwt %	71.1	84.5	79.8
% pasture eaten as % of diet	73.4	82.9	71
Risk			
Op Profit margin%	5%	17%	7%
Total operating Expenses	$1,009,494	$920,137	$1,013,508
Pasture as % of Total Consumed	74%	83%	83%
Solvency			
Equity	$5,460,000	$5,452,000	$5,452,000
Equity %	65%	65%	65%
Environmental			
Change in Kg of N leached.		-19	-18
Kg of N leached/Ha	44	25	26
Kg of N leached effluent area only.	49	23	30
$ change in op profit less new debt/change in kg of N leached		**$ 25.96**	**$ 6.01**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 25.74**	**$ 6.06**
Kg of P Runoff/Ha	3.4	3.2	3.6
N Conversion Efficiency %	19	26	21
g N leached/Kg MS	55.0	29.9	31.7
GHG/kg MS	12	9.8	10
Effl area/required %	127%	127%	229%

Farm ID: NW2 Milk Price: $5.50/kg MS	Base Model 44 kg N/ha/yr	Scenario 1 25 kg N/ha/yr	Scenario 2 -26 kgN/ha/yr (No Winter grazing)
Business – Profit			
Asset Value Total	8,400,000	8,400,000	8,400,000
Total Liabilities	2,940,000	2,940,000	2,940,000
Debt servicing at 8%	235,200	235,200	235,200
Any additional debt	0	8000	8000
Operating Profit less new debt servicing	258,882	401,875	285,333
Total Operating Profit	258,882	402,515	285,973
GFI/Ha	4,612	4,810	4,725
Op Profit less debt servicing	23,682	167,315	50,773
Operating Profit/Ha	941	1464	1040
ROA%	3.08%	4.79%	3.40%
ROE %	0.43%	3.06%	0.93%
Bought in Feeds T/DM/Ha	2.21	0.68	2.38
Pasture Harvested	**9.83**	**9.32**	**9.46**
Efficiency Measures			
MS/Ha	800	836	821
MS/Cow	328	377	376
Kg Dm/Kg MS	15.0	12.0	14.4
Kg MS/kg Cow lwt %	71.1	84.5	79.8
% pasture eaten as % of diet	73.4	82.9	71
Risk			
Op Profit margin%	20%	30%	22%
Total operating Expenses	$1,009,494	$920,137	$1,013,508
Pasture as % of Total Consumed	74%	83%	83%
Solvency			
Equity	$5,460,000	$5,460,000	$5,460,000
Equity %	65%	65%	65%
Environmental			
Change in Kg of N leached.		-19	-18
Kg of N leached/Ha	44	25	26
Kg of N leached effluent area only.	49	23	30
$ change in op profit less new debt/change in kg of N leached		**$ 27.77**	**$ 5.42**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 27.53**	**$ 5.50**
Kg of P Runoff/Ha	3.4	3.2	3.6
N Conversion Efficiency %	19	26	21
g N leached/Kg MS	55.0	29.9	31.7
GHG/kg MS	12	9.8	10
Effl area/required %	127%	127%	229%

NW2 SWOT– Base vs. Low leaching of 26 kg N/ha/yr (No Wintering Off)

Strengths

- This model makes better use of the effluent being produced by storing it and only using it at optimum times. It is also to be used on the crop therefore reducing the requirement of fertiliser on this crops
- This model is more profitable than the current management
- Lower capital required due to the lower cow numbers
- Lower reliance on nitrogen and therefore volatility in cost of N
- By having only 1 crop as opposed to both a winter and a summer crop it means that there is less time that the large area is out of rotation. Currently the 15 ha swedes are out for over 12 months and the turnips approximately 7-8 months. The chicory crop will be treated similar to a pasture in terms of the rotational grazing and can then be grazed hard then direct drilled with an annual which will greatly reduce the time that this area is out of rotation.
- Chicory will reduce the risk of sediment and coliform runoff compared to turnips and swedes as the crop is rotationally grazed and regrows therefore doesn't have the same fallow period that a swede or turnip crop has this also reduces the mineralisation and consequently leaching of nitrogen from the land when fallow
- Lower intensity system should mean less time requirements on current labour units. Probably not enough to reduce labour units but lead to lower work hours
- This property can reduce nitrogen leaching without installing a feed pad

Weaknesses

- This model is slightly more dependent on imported feed and therefore higher risk of volatile feed costs
- Direct drilling crops can cause a reduction in yield if it is not carefully managed
- The chicory followed by annual may not give as much winter feed as a swede crop would.
- Direct drilling the chicory crop in does not give the opportunity to re-contour and use the mechanical cultivation to help break-up the stumps etc.
- When planting a new crop often not entirely aware of potential pests that can drastically reduce yield or cause crop failure
- Capital required for installing effluent holding pond

Opportunities

- Dropping the stocking rate gives the opportunity to select the best cows from the current herd and sell 70 of the worst cows
- Opportunity to increase the profitability of the system whilst reducing the impact on the environment
- More profitable use of the effluent through storing it and applying during optimum times and use to fertilise the crop.
- Opportunity to become a leader and showcase in the agriculture industry. To minimise impact on the environment and become more profitable
- Having a system which is profitable and can be run under a low leaching system may lead to an increase in the value of the land.

Threats

- There may be a gap in the knowledge in terms of growing a successful chicory crop and pests and weeds that reduce yield
- The model assumes current labour units have the skills to manage the pasture covers throughout the season under a lower stocking rate system
- Reducing nitrogen application on a forestry conversion may lead to greater than expected reduction in pasture production due to the great immobilization of N in the soil

- This model is currently in the developing phase, at this stage conversion farms are considered to be in this developing stage for up to 10 years? At some stage it may be under-predicting nitrogen leaching. Following the transition to the developed stage may increase the compliance required to maintain at lower N leaching levels
- Threat of volatile feed prices for feeds that are being brought in.
- Not fully utilizing the money invested in the land, buildings and infrastructure in terms of running the most profitable system if the payout increases.

Low Intensity Dairy

Average Waikato

Model based on DairyNZ average forecast model for 2008-09 (from Dairy Base)
Adjusted for forecast costs/income

Base Model Assumptions

- 324 cows, 104 ha,
- Nitrogen applied as fertiliser 144 kg N/ha/year
- Young stock off from 9 months, no winter grazing off.
- No feed pad, bought in supplements fed in paddock or trailers.
- Small effluent pond which holds couple days of effluent
- Pasture harvested 11.2 T DM,
- Milk production 967kg MS/ha, 328/cow
- 10 Ha of pasture silage imported
- Land – 922 MS/ha x 104 ha at $32/kg = $3,068,416
- Debt is assumed at 35%
- Leaching 52 kg N/ha/year

Scenario1- leaching from 52kg N/ha/yr to 34kg N/ha/yr

- Removed winter application of N (27kg)
- Reduced N use to 100 kg N/Ha/yr
- Grazed 70% of cows off in winter for 8 weeks
- Removed imported supplement due to grazing off
- Young stock grazed off from weaning as opposed to 9 months
- No use of DCD
- 10 ha Chicory crop grown, direct drilled
- Milk production increased to 1041 kg MS/ha; 336kg MS/cow

Scenario 2 - leaching from 52kg N/ha/yr to 26kg N /ha/yr

- Dropped SR to 2.7 cows/ha or 260 of the better cows in herd.
- Grew 5 ha of Maize silage at home using effluent and minimum tillage
- Grew 10 ha of Chicory for summer feed – effluent and minimum tillage techniques (grew 10T from December to May)
- Reduced bought in feed to 37T DM maize
- N use dropped to 50kg N/ha over high response months only.
- Average cow weight of the 260 remaining cows slightly larger.
- MS per cow up to 406 kg MS/cow. Total of 105656 kg MS
- 70% of cows grazed off in winter 2 months (182 cows off), slightly extended lactation – 4 days.

Scenario 3 – leaching from 52 kg N/ha/yr to 26 kg N/ha/yr (No winter grazing off)

- N applied dropped from 180 kg N/ha/yr (milking platform) to average a use of 80 kg N (including DCD) use across whole farm. Took out winter and early Autumn applications

- Reduced SR by 17% to better suit feed supply and demand. 260 cows down from 312, doing 460 kg MS per cow. Cow size was increased, via a breeding programme, from 440 kg cows to 490 kg Friesian cows. Sold poorer producers.
- 4.6 T DM/cow eaten as pasture on the property, with maize silage imported to feed on feed pad.
- Fed around 900 kg DM per cow of imported maize silage per annum which increased N conversion efficiency to 38%.
- Young stock grazed off from 120 days, not 9 months. Fewer replacements kept (17% fewer)
- Used DCD across who farm, growth rates increased from April to October by 2%
- Similar pasture, crop and conserved feed intake to total base model, more crop used however.
- 10 ha of Chicory (minimum tillage) planted to provide summer feed to extend lactation,
- Effluent collected from feed pad and spread on chicory crop
- Built feed pad with drying area for effluent, which has solids separated and dried, for summer crop application. $130,000 Capital cost
- Asset Value adjustment made for fewer cows, more shares, and the feed pad infrastructure resulting in a net change of $110,239 more debt than the base.

Farm ID: Average Waikato Milk Price: $4.55/kg MS	Base Model 50 kg N/ha/yr	Scenario 1 33 kg N/ha/yr	Scenario 2 - 26 kg N/ha/yr (winter off)	Scenario 3 - 26 kg N/ha/yr (no winter graze)
Business – Profit				
Asset Value Total	3,731,476	3,731,476	3,731,476	3,731,476
Total Liabilities	1,306,016	1,306,016	1,306,016	1,306,016
Debt servicing at 8%	104,481	104,481	104,481	104,481
Any additional debt	0	0	0	110,000
Debt servicing total debt (if changed)	104,481	104,481	104,481	113,281
Total Operating Profit less New Debt Servicing	60,463	95,839	109,390	134,009
Total Operating Profit	60,463	95,839	109,390	142,809
GFI/Ha	4766	5111	4877	5441
Op Profit less debt servicing	-44,018	-8,642	4,908	38,327
Operating Profit/Ha	581	921	1052	1373
ROA%	1.62%	2.57%	2.93%	3.83%
ROE %	-1.81%	-0.36%	0.20%	1.66%
Bought in Feeds T/DM/Ha	1.63	0.02	0.37	2.18
Pasture Harvested	**11.2**	**11.5**	**11.0**	**10.9**
Efficiency Measures				
MS/Ha	967	1041	1016	1118
MS/Cow	328	353	414	456
Kg Dm/Kg MS	13.24	11.05	11.17	11.91
Kg MS/kg Cow lwt %	63.8	65.4	76.6	78
Risk				
Op Profit margin%	12%	18%	22%	25%
Total operating Expenses	435190	435773	397784	423109
Pasture as % of Total Consumed	88	89	82	82
Solvency				
Equity	$ 2,425,460	$ 2,425,460	$ 2,425,460	$ 2,315,460
Equity %	65%	65%	65%	65%
Environmental				
Change in Kg of N leached.		-17	-24	-24
Kg of N leached/Ha	50	33	26	26
Kg of N leached effluent area only.	38	31	29	30
$ change in Op Profit less New Debt/Change in kg N leached		**$ 20.01**	**$ 19.60**	**$ 29.47**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 20.00**	**$ 19.63**	**$ 33.00**
Kg of P Runoff/Ha	0.9	0.9	0.8	0.9
N Conversion Efficiency %	26	38	47	38
g N leached/Kg MS	51.7	31.7	25.6	23.3
GHG/kg MS	11.3	9.4	8.5	8.8
Effl area/required %	125%	125	125	200

Farm ID: AD average Waikato Milk Price: $5.50/kg MS	Base Model 50 kg N/ha/yr	Scenario 1 33 kg N/ha/yr	Scenario 2 - 26 kg N/ha/yr (winter off)	Scenario 3 - 26 kg N/ha/yr (no winter graze)
Business – Profit				
Asset Value Total	3,731,476	3,731,476	3,731,476	3,731,476
Total Liabilities	1,306,016	1,306,016	1,306,016	1,306,016
Debt servicing at 8%	104,481	104,481	104,481	104,481
Any additional debt	0	0	0	110000
Debt servicing total debt (if changed)	104,481	104,481	104,481	113,281
Total Operating Profit less New Debt Servicing	154,946	197,676	209,387	243,864
Total Operating Profit	154,946	197,676	209,387	252,664
GFI/Ha	5,674	6,091	5,838	6,497
Op Profit less debt servicing	50,464	93,194	104,905	148,182
Operating Profit/Ha	1490	1900	2013	2429
ROA%	4.15%	5.30%	5.61%	6.77%
ROE %	2.08%	3.84%	4.33%	6.40%
Bought in Feeds T/DM/Ha	1.63	0.02	0.37	2.18
Pasture Harvested	**11.2**	**11.5**	**11.0**	**11.0**
Efficiency Measures				
MS/Ha	967	1041	1016	1118
MS/Cow	328	353	414	456
Kg Dm/Kg MS	13.2	11.1	11.2	11.9
Kg MS/kg Cow lwt %	63.8	65.4	76.6	78
Risk				
Op Profit margin%	26%	31%	34%	37%
Total operating Expenses	435190	435773	397784	423109
Pasture as % of Total Consumed	88	89	82	75
Solvency				
Equity	$ 2,425,460	$ 2,425,460	$ 2,425,460	$ 2,315,460
Equity %	65%	65%	65%	62%
Environmental				
Change in Kg of N leached.		-17	-24	-24
Kg of N leached/Ha	50	33	26	26
Kg of N leached effluent area only.	38	31	29	30
$ change in Op Profit less New Debt/Change in kg N leached		**$ 24.17**	**$ 21.81**	**$ 35.62**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 24.12**	**$ 21.79**	**$ 39.13**
Kg of P Runoff/Ha	0.9	0.9	0.8	0.9
N Conversion Efficiency %	26	38	47	38
g N leached/Kg MS	50	30	30	20
GHG/kg MS	11.3	9.4	8.5	8.8
Effl area/required %	125	125	125	200

Average Waikato SWOT – Base vs. Low leaching 26 kg N/ha/yr (no wintering off)

Strengths

- Lower N leaching, the farm now leaches only 26 kg N/ha/yr, compared with the 50 kg/ha/yr leaching in the base model.
- There is lower N fertiliser use, from an assumed 140kg of N/ha/yr to 80 kg /N/ha/yr (incl. DCD). This is now used in the period of the year when the best response is generated.
- Environmentally compliant, while improvements in profitability are made.
- The farm is now more profitable under the proposed low leaching scenario (ROA improves from 1.62% at $4.55/kg MS to 2.93%; this is an increase of 80%).
- At lower long term milk prices ($4.55/kg MS) and average feed prices the farm is able to generate around $400 more operating profit per ha, thereby assisting greatly with the debt servicing.
- More MS per cow and per ha is achieved at a lower risk.
- There are fewer cows to milk therefore lowering labour demands, however this is not likely to be enough to reduce labour units employed.
- There is an improvement in feed conversion efficiency of all feed by 15%. This due to more MS production relative to maintenance.
- The level of MS production can be partially achieved by the reduction of the poorer quality cows from the herd. The herd reduces from 312 cows to 260 of the better cows.
- A lower stocking rate means that there is more of a buffer in the system should there be more climatic volatility
- GHG emissions with this model are 25% less/kg product. This will be a strength should agriculture be included in an ETS in the future.

Weaknesses

- A lower stocking rate increases the risk of poor pasture management. There will need to be a higher level of skill in the pasture management at the peak growth periods of the year. This may involve a little more monitoring than the base model. The use of crops and more feed conserved will assist in pasture control in the spring.
- There is the use of crop – at a level of 10% of the farm on an annual basis, which is then returned to grass. There is a risk that if this crop is not managed well, it may lead to a feed deficit at a critical time of year. Up-skilling may be required
- Direct drilling chicory for the crop will require sound establishment techniques. There may need to be up skilling in this area. The crop yields & costs are based on a minimum till technique.

Opportunities

- Dropping the stocking rate gives an opportunity to select the best cows in the herd and sell the worst performers.
- There is an opportunity to lower the debt profile, while improving debt servicing ability through improved profitability
- Having an environmentally compliant system may improve on the value and sale -ability of the land in the future, this system can be both profitable and a low impact system if managed well.
- Should the markets in the future demand more transparency around environmental compliance, the product from this farm will be credible.

Threats

- Due to the need to lift cow production, there will be a need to take outside advice, or undertake some up skilling. This model depends on a lift in ability of the operators.
- This model, like the base model is vulnerable to volatile climatic events such as drought etc.
- Should the practice of winter grazing off in the future become a concern, then this scenario will have to reassess how it manages the winter N leaching losses.

PG1

Base Model Assumptions – YIYO

- 100 ha total, 95 ha effective milking
- 286 cows, 60 R1 hfrs, 273 cows milked December.
- 2 extra cow deaths and 2 extra cows sold to balance numbers in stock reconciliation
- 12 ha effluent, effluent spread from sump, no feedpad
- R2 hfrs grazed off till 15th July
- Milk production at 110,500 kg MS/yr
- Purchased feed 84t DM maize silage and 52t PKE in line with what was fed. Cost based on $270/t.
- Pasture baleage (46 bales) harvested November was assumed to be fed April/May
- 5 ha turnips grown
- 4 applications of N, total N applied 122 kg/ha. Response of 10 kgDM/kgN
- Animal health, Electricity, Breeding, Shed, Fertiliser, Wages, R & M, Vehicle, Admin, Rates and Insurance as per client accounts.
- Model expenses used for N, Management Wage and Depreciation
- Capital values of stock based on 2009 IRD livestock values, land and buildings (incl. shares) $32,000/ha and plant and machinery assessed at $100,000.

Scenario 1: N leaching from 45 kg N/ha/yr to 35 kgN/ha/yr

- Effluent area increased to 16 ha. Extra capital cost of $10,000.
- 40% of herd wintered off from beginning June to end of July.
- No winter N applied vs. 27kg/ha applied in the winter months in the Base model.
- Cow numbers reduced to 255.
- Supplements reduced to 20t DM maize silage and 20t PKE.
- 10% more silage harvested on effluent area.
- Production 101,818 kgMS, 8% drop compared to base.
- Nutrient management plan estimated 13% production drop.

Scenario 2: N leaching from 45 kg N/ha/yr to 28 kgN/ha/yr

- Effluent area increased to 20 ha. Extra capital cost of $20,000 above base.
- 100% of herd wintered off June and July and 20% off over August.
- No winter N applied and total nitrogen reduced from 122 kg N/ha/yr to 50 kgN/ha/yr.
- Cow numbers reduced to 255, same as scenario 1.
- Cow liveweight increased 40kg to 480kg.
- Supplements reduced to 20t PKE and no maize silage.
- 10% more silage made on effluent area.
- Production 110,425 kg MS

Scenario 3: N leaching from 45 kg N/ha/yr to 27 kgN/ha/yr (no wintering off)

- Effluent area decreased to 14 ha.
- Cow numbers reduced to 225; 2.3 cows/ha.
- Cows wintered on, replacement heifers grazed off from weaning.
- No winter N applied and total Nitrogen application reduced from 122 kg N/ha/yr in the base to 30 kgN/ha/yr.

- Purchased supplements reduced to 18t PKE and 0t maize silage.
- Crop changed to chicory and area increased from 5 ha to 13 ha.
- No significant loss in productivity

Farm ID: PG1 Milk Price: $4.55/kg MS	Base Model 45 kg N/ha/yr	Scenario 1 35 kg N/ha/yr	Scenario 2 28 kg N/ha/yr	Scenario 3 - 27 kg N/ha/yr (no winter grazing)
Business – Profit				
Asset Value Total	3,666,166	3,625,615	3,625,615	3,585,723
Total Liabilities	1,200,000	1,200,000	1,200,000	1,119,557
Debt servicing at 8%	96,000	96,000	96,000	89,565
Any additional debt		10,000	20,000	
Debt servicing total debt (if changed)	96,000	96,800	97,600	89,565
Total Operating Profit	105,612	104,811	129,035	117,573
Total Operating Profit less new debt servicing	105,612	104,011	127,435	117,573
GFI/Ha	$5,610	$5,180	$5,654	$4,811
Op Profit less debt servicing	9,612	8,811	33,035	28,008
Operating Profit/Ha	1,111	1,103	1,358	1,237
ROA%	2.91%	2.89%	3.56%	3.28%
ROE %	0.39%	0.36%	1.36%	1.14%
Bought in Feeds T/DM/Ha	1.42	0.42	0.21	0.15
Pasture Harvested	**11.79**	**11.25**	**11.60**	**11.12**
Efficiency Measures				
MS/Ha	1,150	1,063	1,162	983
MS/Cow	393	409	442	425
Kg Dm/Kg MS	11.7	11.0	10.2	11.5
Kg MS/kg Cow lwt %	95.4	98.2	97.4	94
Risk				
Op Profit margin%	20%	21%	24%	26%
Total operating Expenses	$432,560	$387,343	$408,076	$337,652
Pasture as % of Total Consumed	87	93	95	88
Equity	$2,466,166	$2,425,615	$2,425,615	$2,466,166
Equity %	67%	67%	67%	69%
Environmental				
Change in Kg of N leached.	0	-10	-17	-19
Kg of N leached/Ha	45	35	28	26
Kg of N leached effluent area only.	39	30	24	30
$ change in Op Profit less new debt/change in N leached		**-$ 1.69**	**$ 13.51**	**$ 6.63**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 0.80**	**$ 14.53**	**$ 6.63**
Kg of P Runoff/Ha	0.8	0.8	0.8	0.9
N Conversion Efficiency %	33	39	48	42
g N leached/Kg MS	39.1	32.9	24.1	26.4
GHG/kg MS	9.7	9.1	7.7	8.7
Effl area/required %	145	208	263	192

Farm ID: PG1 Milk Price $5.50/kg MS	Base Model 45 kg N/ha/yr	Scenario 1 35 kg N/ha/yr	Scenario 2 28 kg N/ha/yr	Scenario 3 - 27 kg N/ha/yr (no winter grazing)
Business – Profit				
Asset Value Total	3,666,166	3,625,615	3,625,615	3,585,723
Total Liabilities	1,200,000	1,200,000	1,200,000	1,119,557
Debt servicing at 8%	96,000	96,000	96,000	89,565
Any additional debt	0	10,000	20,000	
Debt servicing total debt (if changed)	96,000	96,800	97,600	89,565
Total Operating Profit	203,328	200,202	233,536	205,934
Total Operating Profit less new debt servicing	203,328	199,402	231,936	205,934
GFI/Ha	6,762	6,184	6,754	5,741
Op Profit less debt servicing	107,328	104,202	137,536	116,369
Operating Profit/Ha	2,140	2,107	2,458	2,167
ROA%	5.55%	5.52%	6.44%	5.74%
ROE %	4.35%	4.30%	5.67%	4.72%
Bought in Feeds T/DM/Ha	1.42	0.42	0.21	0.15
Pasture Harvested	**11.79**	**11.25**	**11.60**	**11.12**
Efficiency Measures				
MS/Ha	1,150	1,063	1,161	983
MS/Cow	393	409	442	425
Kg Dm/Kg MS	11.7	11.0	10.2	11.5
Kg MS/kg Cow lwt %	95.4	98.9	97.4	94
Risk				
Op Profit margin%	32%	34%	36%	38%
Total operating Expenses	$432,560	$387,343	$408,076	$337,652
Pasture as % of Total Consumed	87	93	95	88
Equity	$2,466,166	$2,425,615	$2,425,615	$2,466,166
Equity %	67%	67%	67%	69%
Environmental				
Change in Kg of N leached.		-12	-19	-19
Kg of N leached/Ha	45	33	26	26
Kg of N leached effluent area only.	42	33	27	30
$ change in Op Profit less new debt/change in N leached		**-$ 3.44**	**$ 15.85**	**$ 1.44**
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 2.75**	**$ 16.74**	**$ 1.42**
Kg of P Runoff/Ha	0.9	0.9	0.8	0.9
N Conversion Efficiency %	31	37	46	42
g N leached/Kg MS	39.1	31.0	22.4	26.4
GHG/kg MS	9.9	9.3	7.7	8.7
Effl area/required %	142	202	253	192

PG1 SWOT - Base vs. low leaching 26 kg N/ha/yr (no winter grazing)

Strengths

- Productivity is very similar while reaching environmental targets.
- At both $4.55kg MS and $5.50/kg MS, this farm is slightly more profitable than the base model because of the reduction in the amount of purchased feed.
- Efficiency of production is increased while the environmental impact is minimized.
- There is a lower reliance on nitrogen.
- Less reliance on purchased feed which reduces the exposure to varying feed costs.
- There is better use of effluent in this system, allowing the farm to reduce costs further in terms of bought in fertilizer costs.

Weaknesses

- Up-skilling may be required due to the new crop being grown
- More skill and heavier cows required.

Opportunities

- The ability to adapt to a lower leaching scenario without major infrastructure costs allows this asset to become environmentally compliant without a high degree of expense.
- There may be opportunities for this business to market its product as environmentally compliant, should the market require it to do so.
- In time this may be linked to improved asset value, as environmental compliance is achievable, along with a profitable business model.(6% ROA at 26kg N leached)
- This low nutrient leaching model is also a low GHG emitter per kg of MS which may position it well in the face of agriculture entering an ETS in the future.
- There is better use of effluent in this system, allowing the farm to reduce costs further in terms of bought in fertilizer costs.

Threats

- This model assumes that management is able to adapt to this system with lower cow numbers and less bought in feed and able to control pasture and consequently pasture quality throughout the spring.

DMCD1

Base Model Assumptions – YIYO model

- Medium scale operation 760 cows 345ha including some "runoff area", Low SR (2.3 cows / ha)
- All calves grazed off (100 Dec, 60 May), No winter grazing off
- "Runoff" area used to import feed into the dairy unit and some grazing of calves prior to departure
- High N rates 200-210kg N/ha on the main unit (overall average 174kg N/ha/yr)
- N leaching of 38 kg/ha/yr (pumice soils)
- Minimal feed (150 tonne PKE)
- Some increase of herd numbers being undertaken this season but system has been modelled on the more typical year 2008/09
- All financials based on the cashbook actual from 2008/09 year. Some adjustments made for capital works. Farm was running under a 18% LOSM contract but all costs have been "normalized' to reflect a year in year out situation.
- Some debt excluded from calculations to reflect other off farm investments.

Scenario 1: N leaching from 38 kg N/ha/yr to 33 kg N/ha/yr

- Reduce N use on effluent area from 162kg N/ha – 86 kg N/ha.
- Reduce N use on "main farm" from 210 kg N/ha – 160kg N/ha.
- Consequently overall N use dropped from 174 kg N/ha/yr to 164 kg/ha
- Remove N use during low response times (winter months) to improve efficiency
- Increase PKE use to 170 tonne.
- No change in stocking rate or production (285,000kg MS)
- No wintering off (owners preference)

Scenario 2 – N leaching from 38 kg N/ha/yr to 26kg N/ha/yr

- Reduce N use on effluent area from 86kg N/ha/yr – 68 kg N/ha/yr
- Reduce N use on main farm from 160 kg N/ha/yr– 89kg N/ha/yr
- Winter grazing off of 60% of herd (450 cows for 8 weeks).
- Import 360 tonne maize silage (used $300 / tonne price landed)
- Overall improved production to 296,000kg MS

Scenario 3 – N leaching from 38 kg N/ha/yr to 26kg N/ha/yr (no winter grazing)

- Install Wintering Barn. Assumed capital cost of $1300 / cow or $1,000,000 (rounded)
- Feeding on wintering barn of all grass silage imported plus PKE plus maize silage
- 5 hours grazing per day. Still 8ha of winter crop in the system for additional feed supply as this is part of the overall development of the farm (also no change to N leaching if removed due to relative small area). Would mean that 60% of the herd would graze on crop (outside of wintering barn) and 40% on grass for simplicity of management.
- Maintained current stocking rate and production. Already at a low stocking rate (2.3 cows) and good production (400kg MS/cow) for the area.
- Lift utilization rates from Maize (75 – 90), PKE (85 – no change) due to feeding in wintering barn
- Overall additional feed came from :
    - 100t DM extra maize purchased
    - 36t DM extra maize utilized
    - 75 tonne DM extra pasture utilization (220kg DM/ha) through more timely use of inputs
- Did not use DCD due to profitability and previous use on this farm.
- Increased maize silage from 360 – 460 tonne DM
- Minor decrease in PKE usage (4 tonne)
- Change timing of supplementation policy to provide a better fit to pasture curve

Farm ID: DMCD1 Milk Price $4.55/kgMS	Base Model 38 kg N/ha/yr	Scenario 1 33 kg N/ha/yr	Scenario 2 26 kg N/ha/yr	Scenario 3 – 26 kg N/ha/yr (no wintering off)
Business – Profit				
Asset Value Total	10,000,560	10,000,560	10,000,560	10,000,560
Total Liabilities	2,000,000	2,000,000	2,000,000	2,000,000
Debt servicing at 8%	160,000	160,000	160,000	160,000
Any additional debt	-		-	1,000,000
Total assets if changed in model	10,000,560	10,000,560	10,000,560	11,000,560
Total Liabilities if changed in model	2,000,000	2,000,000	2,000,000	3,000,000
Debt servicing total debt (if changed)	160,000	160,000	160,000	240,000
Total Operating Profit less new debt servicing	268,495	270,207	167,880	158,006
Total Operating Profit	268,495	270,207	167,880	238,006
GFI/Ha	3,782	3,781	4,086	4,093
Op Profit less debt servicing	108,495	110,207	7,880	- 1,994
Operating Profit/Ha	778	783	487	690
ROA%	2.68%	2.70%	1.68%	2.16%
ROE %	1.36%	1.38%	0.10%	-0.02%
Bought in Feeds T/DM/Ha	0.39	0.51	1.41	1.73
Pasture Harvested	**10.0**	**9.9**	**9.1**	**9.3**
Efficiency Measures				
MS/Ha	799	799	860	861
MS/Cow	369	369	396	396
Kg Dm/Kg MS	12.9	12.9	12.0	12.5
Kg MS/kg Cow lwt %	89.7	89.6	93.2	91.6
Risk				
Op Profit margin%	21%	21%	12%	17%
Total operating Expenses	1,036,205	1,034,304	1,241,680	1,173,901
Pasture as % of Total Consumed	96.5	95.3	86	84.2
Solvency				
Equity	8,000,560	8,000,560	8,000,560	8,000,560
Equity %	80	80	80	73
Environmental				
Change in Kg of N leached.		- 5	- 12	- 12
Kg of N leached/Ha	38	33	26	26
Kg of N leached effluent area only.	34	30	27	25
$ change in op profit less new debt/change in kg of N leached		**$ 0.99**	**-$ 24.30**	**-$ 26.69**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 1.00**	**-$ 24.25**	**-$ 7.33**
Kg of P Runoff/Ha	2.7	2.7	2.8	2.8
N Conversion Efficiency %	24	26	33	32
g N leached/Kg MS	50	40	30	30
GHG/kg MS	10.8	10.6	9.6	9.6
Effl area/required %	2.37	2.35	2.70	2.20

Farm ID: DMCD1 Milk Price $5.50/kgMS	Base Model 38 kg N/ha/yr	Scenario 1 33 kg N/ha/yr	Scenario 2 26 kg N/ha/yr	Scenario 3 – 26 kg N/ha/yr (no wintering off)
Business – Profit				
Asset Value Total	10,000,560	10,000,560	10,000,560	10,000,560
Total Liabilities	2,000,000	2,000,000	2,000,000	2,000,000
Debt servicing at 8%	160,000	160,000	160,000	160,000
Any additional debt	-	0	-	1,000,000
Total assets if changed in model	10,000,560	10,000,560	10,000,560	11,000,560
Total Liabilities if changed in model	2,000,000	2,000,000	2,000,000	3,000,000
Debt servicing total debt (if changed)	160,000	160,000	160,000	240,000
Total Operating Profit less new debt servicing	527,158	528,829	445,944	$436,376
Total Operating Profit	527,158	528,829	445,944	516,376
GFI/Ha	4,531	4,531	4,892	4,899
Op Profit less debt servicing	367,158	368829	285,944	276,376
Operating Profit/Ha	1,528	1533	1293	1497
ROA%	5.27%	5.29%	4.46%	4.69%
ROE %	4.59%	4.61%	3.57%	3.45%
Bought in Feeds T/DM/Ha	0.39	0.51	1.41	1.73
Pasture Harvested	**10.0**	**9.86**	**9.07**	**9.27**
Efficiency Measures				
MS/Ha	799	799	860	861
MS/Cow	369	369	396	396
Kg Dm/Kg MS	12.9	12.9	12.0	12.5
Kg MS/kg Cow lwt %	89.7	89.6	93.2	91.6
Risk				
Op Profit margin%	34%	34%	26%	31%
Total operating Expenses	1,036,205	$1,034,304	$1,241,680	$1,173,901
Pasture as % of Total Consumed	96.5	95.3	86	84.2
Solvency				
Equity	8,000,560	$8,000,560	$8,000,560	8,000,560
Equity %	80	80	80	73
Environmental				
Change in Kg of N leached.		-5	-12	-12
Kg of N leached/Ha	38	33	26	26
Kg of N leached effluent area only.	34	30	27	25
$ change in op profit less new debt/change in kg of N leached		**$ 0.97**	**-$ 19.62**	**-$ 21.93**
$ change in Op Profit/change in Kg of N leached whole farm		**$ 1.00**	**-$ 19.58**	**-$ 2.58**
Kg of P Runoff/Ha	2.7	2.7	2.8	2.8
N Conversion Efficiency %	24	26	33	32
g N leached/Kg MS	50	40	30	30
GHG/kg MS	10.8	10.6	9.6	9.6
Effl area/required %	2.37	2.35	2.70	2.20

DMCD1 SWOT – Base vs. low leaching 26 kg N/ha/yr (no winter grazing)

Strengths

- Higher overall production from greater per cow efficiency
- Higher production increases ability to capitalise on higher payouts when they occur
- Lower nitrogen inputs and more spread application to gain better efficiencies of nitrogen used
- Lower GHG emissions
- Higher feed utilisation
- Reduced pugging
- Higher N conversion efficiency

Weaknesses

- Reduced profitability from significantly increased costs
- High cost of removing N from the system
- High risk (17% profit margin)
- More reliance on feed bought in from outside the farm gate and the potential exposure to more seasonal risk – potential issues with non supply in drought years
- Higher labour/time costs with significant extra feeding out time
- Reduced pasture utilisation
- Negative operating profit at current payouts
- Increased debt – higher risk
- Reduced ROA (2.68% - 2.16%) and a negative ROE (-0.02%)
- Reduced equity % (73% low leaching vs. 80% in the base)
- Additional overall intensity of winter operation increases winter labour demand (traditional "down time")
- Higher machinery demand will potentially increase R&M costs and mean higher replacement rate
- Increased energy costs (fuel) and exposure to the risks of higher fuel
- Increased effluent to be spread
- Possibly more machinery required due to higher feeding out requirements
- Additional R & M costs on races given need to move cows to herd home each day as well as paddock grazing.

Opportunities

- Further improve feed efficiency through use of the feedpad
- Greater opportunities for additional feed types
- Need to fully assess the value of the inputs and potential impact on reducing fertiliser costs.
- Improved market value of property given it could be marketed as more "sustainable"

Threats

- Increased returns on dairy support land from other commodities – i.e. improved sheep, beef or cropping returns. These alternatives will always set the market for price and availability of dairy support land i.e.
- Continuing to be able to source quality labour to run the system – becoming quite tailored.
- When to enter such an operation could be dependent on timing of regulation i.e. if "grandparenting" were to be used as in the Taupo catchment, the farmer is best to continue current practices until regulation is in place to give a higher N allowance.
- Reduced payouts forcing uneconomic supplementation use and not being able to capitalise on the feedpad investment.

DBM1

Base model Assumptions -YIYO Model

- 74 ha total, 72 ha effective milking.
- 185 Cows; 2.6 cows/ha
- Spring calving
- Simple efficient well run system.
- Farm receives 4 applications of N at 34 kg N/ha.(total 136 kg N/Ha)
- Production is typically 1170 kg MS/ha and 460 kg MS/cow from large (550 kg Friesian cows)
- Nitrogen leaching 42 kg N/ha/yr

Feed Bought in

- PKE 90T at $270/T as fed
- 120 bales hay

Scenario 1 – N leaching from 42 kg N/ha/yr to 32 kg/ha/yr

- DCD applied as per criteria set out in Overseer. Pasture growth rates increased 2% from April to October
- N applied as urea on the effluent area lowered from 60kg N/ha/yr to 30kg N/ha/yr.
- N applied as urea on the main platform lowered from 150 to 88kg N/ha/yr (including DCD).
- PKE usage increased from 90 T to 126 T/yr
- Production maintained at 1170 kgMS/cow and 460 kgDM/cow

Scenario 2 – N leaching from 42 kg N/ha/yr to 26 kg N/ha/yr (no wintering off)

- DCD applied as per criteria set out in Overseer. Pasture growth rates increased 2% from April to October
- N applied as urea on the effluent area lowered from 60kg N/ha/yr to none applied.
- N applied as urea on the main platform lowered from 150kg N/ha/yr to none applied (leaving only the 13kg N applied with the DCD).
- Cow numbers reduced from 185 to 170; production reduced accordingly from 84,699 kg MS/yr to 72,000kg MS/yr.
- No supplements imported.
- Replacement rate maintained at 22%
- 120 bales hay bought, and 74T PKE

Farm ID: DBM 1 Milk Price $4.55/kg MS	Base Model 42 kg N/ha/yr	Scenario 1 32 kg N/ha/yr	Scenario 2 - 26 kg N/ha/yr (no wintering off)
Business – Profit			
Asset Value Total	3,001,160	3,001,160	2,979,947
Total Liabilities	1,000,000	1,000,000	1,000,000
Debt servicing at 8%	80,000	80,000	80,000
Any additional debt	0	0	0
Debt servicing total debt (if changed)	80,000	80,000	80,000
Total Operating Profit	44,336	32,084	27,502
GFI/Ha	5552	5597	5153
Op Profit less debt servicing	-35664	-47916	-52498
Operating Profit/Ha	616	445	381
ROA%	1.48%	1.07%	0.92%
ROE %	-1.78%	-2.39%	-2.65%
Bought in Feeds T/DM/Ha	1.87	1.87	1.98
Pasture Harvested	**11.55**	**11.55**	**10.85**
Efficiency Measures			
MS/Ha	1176	1187	1094
MS/Cow	460	460	466
Kg Dm/Kg MS	11.7	11.6	11.9
Kg MS/kg Cow lwt %	93.4	93.4	84.6
Risk			
Op Profit margin%	11%	8%	7%
Total operating Expenses	$366,568	$373,021	$333,180
Pasture as % of Total Consumed	86%	86%	85%
Solvency			
Equity	$2,001,160	$2,001,160	$1,979,947
Equity %	67%	67%	66%
Environmental			
Change in Kg of N leached.		-10	-16
Kg of N leached/Ha	**42**	**32**	**26**
Kg of N leached effluent area only.	40	34	30
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 17.10**	**-$ 14.69**
Kg of P Runoff/Ha	0.8	0.8	0.8
N Conversion Efficiency %	34	41	51
g N leached/Kg MS	35.4	27.0	23.8
GHG/kg MS	8	7.3	7.1
Effl area/required %	250	250	270

Farm ID: DBM 1 Milk Price $5.50/kg MS	Base Model 42 kg N/ha/yr	Scenario 1 32 kg N/ha/yr	Scenario 2 - 26 kg N/ha/yr (no wintering off)
Business – Profit			
Asset Value Total	3,001,160	3,001,160	2,979,947
Total Liabilities	1,000,000	1,000,000	1,000,000
Debt servicing at 8%	80,000	80,000	80,000
Any additional debt	0	0	0
Debt servicing total debt (if changed)	80,000	80,000	80,000
Total Operating Profit	124,639	113,082	102,296
GFI/Ha	6637	6691	6163
Op Profit less debt servicing	44639	33082	22296
Operating Profit/Ha	1731	1570	1420
ROA%	4.15%	3.77%	3.43%
ROE %	2.23%	1.65%	1.13%
Bought in Feeds T/DM/Ha	1.87	1.87	1.98
Pasture Harvested	**11.55**	**11.55**	**10.85**
Efficiency Measures			
MS/Ha	1176	1187	1094
MS/Cow	460	460	466
Kg Dm/Kg MS	11.7	11.6	11.9
Kg MS/kg Cow lwt %	93.4	93.4	84.6
Risk			
Op Profit margin%	25%	23%	22%
Total operating Expenses	346,568	373,021	333,180
Pasture as % of Total Consumed	86%	86%	85%
Solvency			
Equity	$2,001,160	$2,001,160	$1,979,947
Equity %	67%	67%	66%
Environmental			
Change in Kg of N leached.		-10	-16
Kg of N leached/Ha	**42**	**32**	**26**
Kg of N leached effluent area only.	40	34	30
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 16.10**	**-$ 19.44**
Kg of P Runoff/Ha	0.8	0.8	0.8
N Conversion Efficiency %	34	41	51
g N leached/Kg MS	35.7	27.0	23.8
GHG/kg MS	8	7.3	7.1
Effl area/required %	250	250	270

DBM1 SWOT – Base vs. low leaching 26 kg N/ha/yr (no wintering off)

Strengths

- The farm is no longer subject to increasing urea costs.
- The farm is now environmentally compliant
- GHG emissions are reduced by 11% /kg MS and 24% in absolute terms
- Reduced stocking rate will increase the resilience of the farm through a dry summer

Weaknesses

- Significant drop in operating profit means the business can only just cover financing costs at a $5.50 payout
- Removing N and bought in supplement from the system meant a reduced stocking rate has to be carried through the winter which has implications for controlling pasture quality during the spring period
- A reduced ability to respond to a difficult winter.
- Higher skill level in terms of pasture management required to preserve pasture quality through the spring as a consequence of the reduced stocking rate.

Opportunities

- Small advantages in terms of increased herd culling potential

Threats

- This business is in a high risk position, even in the base model. The reduction of the small profit it was making makes this business even more precarious from a financial perspective.

Organic Dairy Farm DBM2

Base Model Assumptions -YIYO Model

- 70 Ha total; 67.5 Ha effective milking.
- 155 Cows
- Spring calving
- Currently in 2nd year of a 3 year conversion from conventional to becoming an Organic Certified producer.
- Because of the difficult autumn last year 72 t PKE was bought in consultation with certifiers. This will not be an option moving forward.
- The production in the base model has been assumed at 58,500 kg MS; 866 kg MS/ha; 377kg MS/cow.
- Premium for organics is $1.05 and this has been included as additional to the prescribed payouts i.e. a $5.50/kg MS payout becomes $6.55/kg MS
- No Nitrogen is used and no bought in feed
- Nitrogen leaching of 38 kg N/ha/yr

Scenario 1 – N leaching from 38 kg N/ha/yr to 35 kg N/ha/yr

- The nutrients by form featuring in this nutrient budget are derived from 1T/ha composted goat manure.
- Herd numbers reduced from 155 to 140 cows, production from 58,500 kg MS/yr to 57,913kg MS/yr.
- Production is 858 kgMS/ha and 426 kgMS/cow
- N leaching reduced from 38kg N/ha/yr to 35 in this scenario.

Scenario 2 – N leaching from 38 kg N/ha/yr to 26 kg N/ha/yr (no wintering off)

- The nutrients by form featuring in this nutrient budget are derived from 1T/ha composted goat manure.
- Herd numbers reduced from 155 to 95 cows, production from 58,500 kg MS/yr to 50,000kg MS/yr.
- 740kgMS/ha and 526 kgMS/cow
- Young stock off the dairy platform at weaning.
- Because of the low stock numbers 14 ha of the farm has been retired and planted in pines. An annual income of $625/ha is assumed from the pines
- N conversion efficiency increased from 38 to 40%.

Farm: ID DBM 2 Milk Price $4.55/kg MS (plus organic premium)	Base Model 38 kg N/ha/yr	Scenario 1 35 kg N/ha/yr	Scenario 2 26 kg N/ha/yr (no winter grazing)
Business – Profit			
Asset Value Total	2,801,150	2,801,150	2,724,716
Total Liabilities	1,280,000	1,280,000	1,280,000
Debt servicing at 8%	102,400	102,400	102,400
Any additional debt	0	0	0
Debt servicing total debt (if changed)	102,400	102,400	102,400
Total Operating Profit	122,777	118,817	83,922
GFI/Ha	4,840	4,771	4,207
Op Profit less debt servicing	20377	16417	-18478
Operating Profit/Ha	1819	1760	1243
ROA%	4.38%	4.24%	3.08%
ROE %	1.34%	1.08%	-1.28%
Bought in Feeds T/DM/Ha	0.06	0.05	0.07
Pasture Harvested	**10.34**	**9.93**	**9.57**
Efficiency			
MS/Ha	868	858	741
MS/Cow	380	426	521
Kg Dm/Kg MS	12.0	11.6	13.0
Kg MS/kg Cow lwt %	80	88	107
Risk			
Op Profit margin%	36%	36%	28%
Total operating Expenses	$216,041	$215,182	$210,570
Pasture as % of Total Consumed	99%	99%	99%
Solvency			
Equity	$1,521,150	$1,521,150	$1,444,716
Equity %	54%	54%	53%
Environmental			
Change in Kg of N leached.		-3	-12
Kg of N leached/Ha	38	35	26
Kg of N leached effluent area only.	49	47	41
$ change in Op Profit/change in Kg of N leached whole farm		-$ 19.67	-$ 48.00
Kg of P Runoff/Ha	1.2	1.2	0.8
N Conversion Efficiency %	37	38	42
g N leached/Kg MS	44.3	40.8	35.1
GHG/kg MS	10.3	10	8.7
Effl area/required %	90	94	118

Farm: ID DBM 2 Milk Price $5.50/kg MS (plus organic premium)	Base Model 38 kg N/ha/yr	Scenario 1 35 kg N/ha/yr	Scenario 2 26 kg N/ha/yr (no winter grazing)
Business – Profit			
Asset Value Total	2,801,150	2,801,150	2,724,716
Total Liabilities	1,280,000	1,280,000	1,280,000
Debt servicing at 8%	102,400	102,400	102,400
Any additional debt	0	0	0
Debt servicing total debt (if changed)	102,400	102,400	102,400
Total Operating Profit	180,414	175,912	133,087
GFI/Ha	5,663	5,587	4,909
Op Profit less debt servicing	78014	73512	30687
Operating Profit/Ha	2673	2606	1971
ROA%	6.44%	6.28%	4.88%
ROE %	5.13%	4.83%	2.12%
Bought in Feeds T/DM/Ha	0.06	0.05	0.07
Pasture Harvested	**10.34**	**9.93**	**9.57**
Efficiency			
MS/Ha	868	858	741
MS/Cow	380	426	521
Kg Dm/Kg MS	12.0	11.6	13.0
Kg MS/kg Cow lwt %	80	88	107
Risk			
Op Profit margin%	46%	45%	39%
Total operating Expenses	$216,041	$215,182	$210,570
Pasture as % of Total Consumed	99%	99%	99%
Solvency			
Equity	$1,521,150	$1,521,150	$1,444,716
Equity %	54%	54%	53%
Environmental			
Change in Kg of N leached.		-3	-12
Kg of N leached/Ha	38	35	26
Kg of N leached effluent area only.	49	47	41
$ change in Op Profit/change in Kg of N leached whole farm		**-$ 22.33**	**-$ 58.50**
Kg of P Runoff/Ha	1.2	1.2	0.8
N Conversion Efficiency %	37	38	42
g N leached/Kg MS	43.8	40.8	35.1
GHG/kg MS	10.3	10	8.7
Effl area/required %	90	94	118

DBM2 SWOT – Base vs. Low leaching 26 kg N/ha/yr (no winter grazing)

Strengths

- Environmental standards meet.
- Because of the organics premium this farm can still operate and still finance debt at a $4.55/kg MS base payout
- Green House gas emissions are reduced by 15.5% /kg MS and 27% in absolute terms
- Production is reduced so much that 14 ha of land can be retired from farming and planted in pines. There is potential for an income stream from the sale of carbon credits from this 14ha.
- Pines mean a small improvement to risk profile through diversification
- Reduced stocking rate will increase the resilience of the farm through a dry summer

Weaknesses

- A significant drop in profit after debt servicing (61%) reduces ability for reinvestment and overall wealth creation in the future
- Reduced operating profit increases exposure to interest rate increases
- Model relies on superior skill levels to lift per cow performance to 107% of body weight. This is very difficult to achieve.
- Higher skill level in terms of pasture management required to preserve pasture quality through the spring as a consequence of the reduced stocking rate.

Opportunities

- Small advantages in terms of increased herd culling potential
- Potential to enter into carbon trading / offsets through the pine plantation

Threats

- The very high per cow production not being achieved
- Resale potential of the farm compromised because of the reduced ability to service debt for new investors

Sheep Beef and Deer Models

SL1 – Sheep & Beef

Base Model Assumptions – YIYO

- 281 ha effective (330 ha total)
- Sheep/Beef Ratio: 40:60
- 12.1 su/ha
- Moderate performing unit.
- 2008/09 the farm changed hands. As part of this change the farming operation had changed moderately, as well as some land area was no longer in the system.
- There is no nitrogen application in this system.
- 8 ha of winter turnips is grown and fed to the bulls.
- 250 bales of silage are made.
- Financial accounts were unavailable. The MAF Farm Monitoring was used to give some indicative costs. The FWE/GFI appears to be low at 42% which may have an impact on profitability.
- Assets – there was no rateable values available. The total stock units based on 12.1 su gives 3400 su @ $654/su = $2,223,600.
- Have included $50,000 management fee
- The debt levels were not available. For the purpose of this, as first year in business, there is 60% equity on stock and land values.
- On Farmax have used Schedule 1 for pricing.
- The base model is already reaching the target of leaching 12 kg N/ha/yr and therefore for the purpose of this study a scenario has been run to increase the intensity and profitability of the system which leads to an increase in the nitrogen leaching in the scenario.

Sheep

- The property was intending to grow its current ewe flock from 790 to approximately 850. The greater figure is what was used as the status quo flock.
- Some ewe hoggets had been kept this year, but long term replacements will be bought in.
- Prime lambs sold by end of May.
- Whilst lambing % last year was low, normally 140% achieved in MA Ewes.

Beef

- Buys in 4 day old Friesian bull calves and rears (n=207) and additional bulls required are bought store at 18 – 20 months (autumn)
- These are then sold to Dairy Farmers at a premium at 500 kg as 2 year old bulls.
- Approximately 40 of these bulls are leased out during November/December at $500. On return are finished and sold prime.
- In addition, approximately 20 Hereford or Hereford Cross bulls are purchased as 18 month, and kept for a year selling at 300+ kg CW.

<u>Scenario 1</u> – N leaching from 12 kg N/ha/yr to 14 kg N/ha/yr (increase in intensity and profitability)

- This is more intensive and is 2 stock units greater than the base model, therefore 14.2 stock units. This is as a result of increased bull numbers changing ratio to 38:62 sheep:beef.
- Nitrogen was introduced into this system – 40 kg N/ha over 175 ha (beef and yearling blocks).
- Overall policy has remained the same otherwise.

Farm ID: SL1	Base Model 12 kg N/ha/yr	Scenario 1 14 kg N/ha/yr
Business – Profit		
Asset Value Total	$2,538,109	$ 2,577,298
Total Liabilities	$1,007,244	$1,007,244
Debt servicing at 8%	$80,579	$80,579
Any additional debt	0	0
Total Liabilities if changed in model	$1,007,244	$1,007,244
Debt servicing total debt (if changed)	$80,579	$80,579
Gross Farm Income (GFI)	$368,474	$433,643
Total operating Expenses (TOE)	$217,638	$233,750
Farm Working Expenses (FWE)	$155,638	$171,750
Total Operating Profit (EFS)	$150,836	$199,893
Operating Profit/Ha	$537	$711
ROA%	5.94%	7.76%
ROE %	4.59%	7.60%
Efficiency		
Tonnes (pasture) Grown (net)	6.17	7.44
Kg cw/ha	270	336
Kg LW wintered	833	947
Kg DM/kg Product	23.62	22.71
$GM/kg Product	3.95	3.64
Risk		
Op Profit margin	41%	46%
FWE/ % GFI	42%	40%
Solvency		
Equity %	60%	61%
Environmental		
Kg of N leached/Ha	12	14
Change in Kg of N leached.		2
$ change in Op Profit/change in Kg of N leached		$87*
Kg of P Runoff/Ha	1	1
GHG	4599	5650
GHG/kg Prod	17.03	16.82

*This scenario considering the effect of increasing the intensity and profitability of the system which has lead to an increase in the nitrogen leached from the system. However these changes have also lead to an increase in the operating profit of the system. For every 1 kg N/ha/yr increase in nitrogen leaching the operating profit has increased by $87.

SL1 SWOT - Base model vs. high nutrient leaching 14 kg N/ha/yr

Strengths

- The low nutrient leaching (12 kg N leached) model does not rely on nitrogen input for the system to work.
- Has lower N leaching.
- Reduced GHG emissions.
- Less supplement is required for this system – time and labour in feeding out.
- Cattle policy is simple and easy to manage.
- Access to niche market through historic networks and in part location.
- Reduced winter liveweight being carried.

Weaknesses

- Less alignment between the supply and demand curves.
- Has a lower Gross Farm Income and a lower Operating Profit.
- Both ROA and ROE is reduced in this model.

Opportunities

- Opportunity to improve sheep efficiency through reduced ewe size and improved litter size and weaning weight.
- Better integration between cattle system and sheep system for animal health benefits.

Threats

- That an environmental event such as drought may require the application of N to maintain the system.
- A drought or severe winter may also reduce the current stocking rate, dropping leaching but also reducing the profitability further.
- Failure of winter turnip crop through pest or environmental.
- Dairy farmers choose not to buy bulls or lease them.
- The personnel skill to manage the system.

DMCSB1 – Sheep & Beef

Base Model Assumptions – YIYO model

- 158ha
- Sheep / Beef/ Deer Ratio 6:10:84
- 18.4 SU / ha
- Relatively high performing unit.
- Significant changes to system over last two years.
- Cattle primarily trading enterprise – taking opportunities when they arise. Have 40 trade cattle in system plus 90 weaner bulls. 13 heifers
- Sheep – reduced numbers after the drought. Flock now stabilised at 100. Full terminal system. Buy all replacements
- Deer – breeding / finishing system (560 hinds) all finished by following April. Target 52-53kg carcass weight
- Expenditure - some adjustments to be made as farm was 31 March balance date. Cash manager accounts used as a base but adjustments made for drought years
- Winter cropping an "easy" system.
- Minimal N used (total 30kg/ha) – split applications
- N Leached of 18kg/ha/yr
- Debt – actual used

Scenario 1 – N leaching from 18 kg N/ha/yr to 15 kg N/ha/yr

- Remove breeding cows from system
- Reduce trading heifers from system
- Reduce N reduction to single dressing on better country (remove hill country dressing)
- Reduce winter crop area from 10ha – 5ha
- Initially infeasible
- Further removal of 90 trade weaners from system to balance
- N leaching now 15kg N / ha

Scenario 2 – N leaching from 18 kg N/ha/yr to 12 kg N/ha/yr

- As per Ballance recommendations
- Reduced deer stock units by 30%
- Sell surplus silage from system (2000bales)
- Allowed for $35,000 of additional fertiliser to be applied to system to replace nutrient loss (PKS) from export of nutrients in the silage sold off farm

Farm ID: DMCSB1	Base Model 18 kg N/ha/yr	Scenario 1 15 kg N/ha/yr	Scenario 2 12 kg N/ha/yr
Business – Profit			
Asset Value Total	$2,627,709	$ 2,627,709	$ 2,627,709
Total Liabilities	$405,000	$405,000	$405,000
Debt servicing at 8%	$32,400	$32,400	$32,400
Any additional debt	0	0	0
Total Liabilities if changed in model	$405,000	$405,000	$405,000
Debt servicing total debt (if changed)	$32,400	$32,400	$32,400
Gross Farm Income (GFI)	$261,427	$236,827	$294,436
Total operating Expenses (TOE)	$193,514	$182,776	$269,493
Farm Working Expenses (FWE)	$133,514	$122,776	$209,493
Total Operating Profit (EFS)	$67,913	$54,051	$24,943
Operating Profit/Ha	$430	$342	$158
ROA%	2.58%	2.06%	0.95%
ROE %	1.60%	0.97%	-0.34%
Physical and Efficiency Measures			
Tonnes (pasture) Grown (net)	8.68	7.83	7.1
Kg c/c/ha	219	186	135
Kg LW wintered	920	770	562
Kg DM/kg Product	41.55	44.02	43.31
$GM/kg Product	4.91	5.47	7.91
Risk			
Op Profit margin	26%	23%	8%
FWE/ % GFI	51%	52%	71%
Solvency			
Equity %	85%	85%	85%
Environmental			
Kg of N leached/Ha	18	15	12
Change in Kg of N leached.		3	3
$ change in Op Profit/change in Kg of N leached	NA	-$ 29.24	-$ 61.41
Kg of P Runoff/Ha	2	2	2
GHG	6343	5722	4711
GHG/kg Prod	28.96	30.76	34.90

DMCSB1 SWOT – Base vs. low leaching 12 kg N/ha/yr

Strengths

- Lower N leaching
- Higher Gross Farm Income
- Lower GHG overall due to reduced stocking rate
- System can be undertaken without significant capital expenditure

Weaknesses

- Lower profitability
- Negative ROE given current debt loading
- Extremely high reliance on exporting silage bales from system. Very high risk system in terms of the ability to be able consistently sell these bales
- High level of nutrient exported from the system
- Higher reliance on fertiliser to replace nutrients and therefore vulnerable to volatile fertiliser process
- Higher GHG / kg product – only due to reduce product out the gate (excludes silage sales)
- Stock policy now primarily deer (no cattle, few sheep) – high risk if deer returns reduce
- High FWE % (risky)

Opportunities

- If economics improve there could be further opportunity to reduce stocking rate and reduce N Leaching however economic viability is driving the need for high stocking rate

Threats

- Inability to sell surplus silage
- Increases in fertiliser costs increasing the cost of the system
- Dairy industry not purchasing extra feed

SL2 – Sheep & Beef

Base Model Assumptions – YIYO model

- 281 ha effective, Sheep/Beef Ratio: 52:48, 12.3 su/ha
- Moderate performing unit.
- The system has remained fairly static over recent years, with any changes made mainly been directed around seasonal impacts (i.e. drought) and financial constraints).
- Nitrogen standard policy is application of 27 kgN/ha on the whole farm on 15th April and 15th August.
- Traditionally a summer crop was planted, but this has ceased in last two years due to financial constraints. Additional baleage was made this last year.
- Expenditure – used 2007/08 accounts and 2008/09 cashbook to give indications of overall Farm Expenditure, and referenced the MAF Monitoring Information.
- Assets – taken land at rateable value, reduced by 25% and then divided by stock units (based on Farmax) to give a per stock unit rate
  Stocking rate 12.4 su/ha over 281 ha gives 3484.4 su.
  Rateable value $3,040,000 less 25% = $2,280,000 = $654/su or $8,056/total ha
- Have included $50,000 management fee
- Debt is based on start of year.
- On Farmax have used Schedule 1 for pricing.

Sheep

- Traditional breeding ewe flock, keeping own replacements and selling prime lambs from December - September.
- Whilst the base year was derived from the 2008/09 year some modifications made to make it more 'normal' were as following:
  - 2008/09 there was a high ewe losses. This has been reduced to 10% losses.
  - Scanning has varied over last three years – therefore average was taken giving 149%. (2007 = 166%, 2008 = 132% and 2009 = 148%.
  - Hogget lambing was low in 2008/09 at only 20%. This has been lifted to a scanning of 80% and 63% lambing.
  - Due to the increased lamb numbers, additional lambs were sold from December to June to give same closing numbers. The average CW was maintained at 16 kg CW.

Beef

- Buy in a mixture of 100 kg bull calves and yearlings and finish through to 270 kg CW at 2 years, with a portion going store at 20 months (n=210).
- A small portion of steers either as 100 kg calves or yearlings are taken through to 2 years at 330 kg CW (n=20).

<u>Scenario 1</u> – N leaching from 15 kg N/ha/yr to 12 kg N/ha/yr

- Dropped ewe numbers by 65, and increased lambing % STS from 118% - 135% (scanning lifted from 149% to 170%).
- Sold all Mixed Sex Lambs by the end of May, with a portion in January going store (under 25 kg).
- Removed all N applications except for the August application on the beef block which is now applied 1st August at same rate of 27 kg N/ha.
- Bought all bulls as 110 kg calves in November (lift from 100 – 280 animals), and sold store at 20 months (January/February average 400 and 366 kg respectively).
- Buy 85 280 kg steers as yearlings (Sept) and take them through to 300 kg CW animals at 27 - 30 months (selling December onwards).
- Reduced the amount of supplement made – baleage from 18 to 15 ha (44 less bales), and hay from 15 to 10 ha (35 less bales), with feeding out starting mid June instead of July.

- The overall fertiliser spend has stayed the same with the savings made on Urea, being spent on other fertiliser.

Scenario 2 – N leaching from 15 kg N/ha/yr to 12 kg N/ha/yr

- Identical to scenario 1 except for the Bull numbers.
- Bull calf numbers dropped from 280 t0 250, selling Jan/Feb.

Farm ID: SL2	Base Model 15 kg N/ha/yr	Scenario 1 13 kg N/ha/yr	Scenario 2 12 kg N/ha/yr
Business – Profit			
Asset Value Total	$2,538,007	$ 2,551,677	$ 2,538,867
Total Liabilities	$1,097,157	$1,097,157	$1,097,157
Debt servicing at 8%	$87,773	$87,773	$87,773
Any additional debt	0	0	0
Total Liabilities if changed in model	$1,097,157	$1,097,157	$1,097,157
Debt servicing total debt (if changed)	$87,773	$87,773	$87,773
Gross Farm Income (GFI)	$239,883	$297,038	$285,931
Total operating Expenses (TOE)	$216,272	$215,138	$214,671
Farm Working Expenses (FWE)	$154,272	$153,138	$152,671
Total Operating Profit (EFS)	$23,611	$81,900	$71,260
Operating Profit/Ha	$84	$291	$254
ROA%	0.93%	3.21%	2.81%
ROE %	-4.45%	-0.40%	-1.15%
Physical and Efficiency Measures			
Tonnes (pasture) Grown (net)	6.57	7.13	6.88
Kg cw/ha	273	321	306
Kg LW wintered	652	703	678
Kg DM/kg Product	24.18	22.92	23.13
$GM/kg Product	1.63	2.44	2.45
Risk			
Op Profit margin	10%	28%	25%
FWE/ % GFI	64%	52%	53%
Solvency			
Equity %	57%	57%	57%
Environmental			
Kg of N leached/Ha	15	13	12
Change in Kg of N leached.		2	3
$ change in Op Profit/change in Kg of N leached		$ 103.72	$ 56.52
Kg of P Runoff/Ha	3	3	3
GHG	5719	5531	5362
GHG/kg Prod	20.95	17.23	17.52

SL2 SWOT – Base vs. Low leaching 12 kg N/ha/yr

Strengths

- This model shows a closer alignment between the supply and demand curves.
- This model does not rely on nitrogen input for the system to work.
- Has lower N leaching.
- Reduced GHG emissions.
- Has a higher Gross Farm Income and marginally lower Farm Working Expenses, giving an overall higher Operating Profit.
- Less supplements are required for this system – time and labour in feeding out.
- Focus is on a higher performing ewe flock at similar numbers.
- Cattle policy is simplified and focuses on a higher proportion of smaller animals.
- Both ROA and ROE is improved in this model.
- Fairly flat farm cover with improved pasture quality.
- 50:50 sheep:beef ratio giving balanced risk.

Weaknesses

- Higher winter liveweight being carried.
- Store bulls – risk of finding a market at this time.
- Buying steers on a grass market.

Opportunities

- The stock buying and selling policy is simplified and does provide flexibility in buying and selling depending on feed, price and availability.
- Opportunity to increase the profitability of the system whilst reducing the impact on the environment
- Improving the efficiency of the ewe flock will provide further opportunities in reducing leaching from maintaining ewe numbers but providing additional stock in the form of lambs.

Threats

- An environmental event such as drought may require the application of N to maintain the system.
- A drought or severe winter may also reduce the current stocking rate, dropping leaching but also reducing the profitability.
- The inability to make or acquire supplements.
- Volatile product prices.
- The personnel skill to manage the system.

DMCS2 – Sheep and Beef

Base Model Assumptions – YIYO model

- 290ha effective
- Sheep / Beef/ Ratio 30:70
- 12.8 SU / ha
- Operation primarily a grazing support unit for 600 cow dairy operation
- Excellent base performance on base sheep and cattle policies
- Dairy grazing undertaken is of a higher standard – excellent heifers grown and strong C.S gains on MA cattle over winter
- Sheep – 130% average lambing, selling 19-20kg cw lambs from February to May, 40% replacement rate taken through but this is reduced in January with half of these sold as 2-tooths.
- Cattle – primarily Angus cattle herd (110 head), heifers all retained and balance not required for replacements are sold at 270-280 kg c/c as R2 cattle. All steers sold at weaning to feed lot
- Dairy grazing 120 head on as calves. Stay on until calving (home in split lots), 180 MA dairy cows for wintering in May - July
- 10ha of Lucerne grown for a simplistic feed supply system
- 9ha of maize grown for dairy farm
- 18ha of winter crop (Swedes) for wintering – followed by Tabu for spring feed
- Silage generally retained for own use on farm
- Only 100ha of mowable country
- Expenditure – some extrapolation required as the farm is operated as one entity with the dairy farm so difficult to get all expenditure accurate
- Debt – "average" used for this size operation due to the implication of the dairy unit
- Nitrogen leaching of 20 kg N/ha/yr

Scenario 1 – N leaching from 20 kg N/ha/yr to 18 kg N/ha/yr

- Reduce N Use from 24kg N / ha to 0 on all blocks that get spring N
- Halve crop area from 18ha to 9ha
- Sell off surplus grass silage (270 bales)
- Reduce angus cattle by 20%
- Reduce hogget's carried over to just 150 replacements required
- Reduce cattle liveweight gains
- Reduce sheep weight gains

Scenario 2 – N leaching from 20 kg N/ha/yr to 12 kg N/ha/yr

As in scenario 1 plus

- Remove all Angus cattle from system
- Remove further 1055 grass silage bales from the system
- Remove Lucerne crop
- Remove maize cropping
- Remove all winter cropping
- No weight gain on winter cattle
- Lower weight gains on heifer replacements

Farm ID: DMCSB2	Base Model 20 kg N/ha/yr	Scenario 1 18 kg N/ha/yr	Scenario 2 12 kg N/ha/yr
Business – Profit			
Asset Value Total	$3,043,852	$ 2,955,222	$ 2,852,460
Total Liabilities	$350,000	$261,370	$158,608
Debt servicing at 8%	$28,000	$20,910	$12,689
Any additional debt	0	0	0
Total Liabilities if changed in model	$350,000	$261,370	$158,608
Debt servicing total debt (if changed)	$28,000	$20,910	$12,689
Gross Farm Income (GFI)	$331,078	$312,873	$309,514
Total operating Expenses (TOE)	$283,955	$267,086	$296,027
Farm Working Expenses (FWE)	$221,955	$205,086	$226,027
Total Operating Profit (EFS)	$47,123	$45,787	$13,487
Operating Profit/Ha	$162	$158	$47
ROA%	1.55%	1.55%	0.47%
ROE %	0.71%	0.92%	0.03%
Physical and Efficiency Measures			
Tonnes (pasture) Grown (net)	6.7	5.6	4.2
Kg cw/ha	215	182	151
Kg LW wintered	1098	921	731
Kg DM/kg Product	32.4	30.91	27.91
$GM/kg Product	3.15	4.03	4.87
Risk			
Op Profit margin	14%	15%	4%
FWE/ % GFI	67%	66%	73%
Solvency			
Equity %	89%	91%	94%
Environmental			
Kg of N leached/Ha	20	18	12
Change in Kg of N leached.		2	6
$ change in Op Profit/change in Kg of N leached		-$ 2.30	-$ 18.56
Kg of P Runoff/Ha	2.6	2.7	2.9
GHG	5303	4274	3226
GHG/kg Prod	24.67	23.48	21.36

DMCSB2 SWOT Base vs. low leaching 12 kg N/ha/yr

Strengths

- Lower N leaching
- Higher GFI
- Lower GHG overall due to reduced stocking rate
- Reduced debt

Weaknesses

- Lower profitability
- Very poor ROE (0.03%)
- Extremely high reliance on exporting silage bales from system. Very high risk system in terms of the ability to be able consistently sell these bales
- High level of nutrient exported from the system in the above
- Higher reliance on fertiliser to replace nutrients
- Complete removal of one enterprise – less diversification and more risk
- No crops in system presents a high risk wintering operation of pasture growth rates are not sufficient to supply required winter feed
- More potential pugging with cows being wintered on grass, particularly hill side damage.
- Significant problems with pasture cover "blow out" in summer – peaking over 3,000kg DM / ha. Significant issues controlling brown top on hills and need to use dairy heifers for clean up – i.e. lower weight gain
- Utilising maximum "mowable area" limits options in a good season – what to do with the surplus
- No weight gain opportunity on winter cows if the full 300 are to be wintered
- High FWE % (risky)

Opportunities

- Create a lower labour input system with low sheep numbers and primarily dairy grazing – contract out the winter grazing to the dairy farm and significantly reduce workload.

Threats

- Dairy farm looking to lower input system and having to sell feed on the open market
- Poor winters and the issues this brings
- Inability to sell surplus silage
- Increases in fertiliser costs increasing the cost of the system
- Lower sheep returns would mean full reliance on dairy grazing income

Glossary of KPI's used

Key Economic Variables for Analysis

Profitability of the Business

The following measures assess and correlate to the level of profitability of a business.

1. **Return on Dairy Assets - ROA** (Operating Profit – lease on land/buildings)/Total Assets at start of year x 100.
   This has been assessed with capital gains excluded. This percentage measure of profitability looks at the total return on assets employed and is a priority to consider in business performance. ROA can be used to compare profitability between farms

2. **Return on Equity** (Operating Profit – Total Financing Costs / Equity at Start of Year x 100)
   This percentage measure of profitability records the return on the equity invested in the business. As this measure includes debt servicing this should not be used to compare between different farms

3. **Change in Equity** (Equity at end of Year – Equity at Start of Year) / Equity at Start of year x 100)
   This percentage measure of profitability records the rate of increase in equity and as a priority should be assessed to identify personal business performance.

4. **Operating Profit (EFS) per Hectare** (Operating Profit/Effective Milking Area.)
   This measure of profitability records the level of profit against the largest capital asset of the business and as a result should be read closely with ROA and consideration needs to be given to the land value.

5. **Pasture Dry Matter Harvested Per Hectare** (t DM/ Ha)
   This generally is a measure that correlates with profit. However is a need to interpret this in the light of land quality and farming system i.e.; irrigation. The term **Calculated Pasture Harvested** is present in the appendix tables on each farm. This is the figure that has been derived from Farmax where the reported figure was the pasture allocated, rather than harvested. So this has been amended to be reported as pasture harvested.

Efficiency of the Business

This is used to assess the level of performance of a business in a specific area. These measures may relate to the use of assets, pasture, supplements and staff. These measures do not always relate to an improvement in profitability, but can give definite insights about a business.

1. **Milksolids per Hectare** – This measures the total amount of milk produced per effective hectare in the base system (note: in scenarios where trees have been planted the milksolids per hectare is still calculated using the effective area in the base model). It will also give a good guide to the level of productivity of the business. The correlation between milk production/ha and profitability is low.

2. **Kg Milksolids per Cow** - This measures the milk produced per cow, and will highlight issues with efficiency in the system.

3. **Kg DM/KG MS** – This is a measure of the total kg DM required to generate a kg of MS. This is derived from the total of the calculated pasture harvested, the conserved feed, and forage crops consumed, as well as the supplements consumed, and

then divided by the MS. It is important that this is reported via Farmax, and does not take into account the consumed feed if cows are wintered off the property. This creates an anomaly between the figures reported in the appendices, with the scenarios using winter grazing off as an option to mitigate N leaching.

4. **Kg MS as % of bodyweight –** This is a figure that is a measure of the output of the cow relative to her total bodyweight as measured on the 1st Dec. This typically gives an indication of how much of her potential is being utilized. In a well balanced ration, with high genetic cows, it is possible that this figure can reach 100-105%.

5. **Kg cw/ha –** This figure is the kg of carcass weight which is removed from the sheep and beef system on a per hectare basis. This gives an indication of the liveweight produced from the system. However this does not include the weight of other products such as velvet which is not a carcass weight figure.

Environmental Efficiencies

1. **Nitrogen leached (g) per Kg Milksolids** (g N/Kg MS) this is a measure of the grams of N leached per kg of MS produced. It can give a guide with regard to the environmental efficiency of the system.

2. **Nitrogen leached kg/Ha** this shows the impact of the losses relevant to the area (resource) farmed.

3. **P Runoff Risk** – whole farm risk of P loss

4. **Kg P Runoff/Ha** – Kg of P loss relevant to the area farmed.

5. **% Effluent System Compliance** – Present area under effluent irrigation relative to the total area required to the irrigated from a regional council perspective or ruling. (Expressed as %)

6. **GHG /kg MS or per Ha** – shows the emissions per unit of production and per Ha

7. **Mitigation Cost per change in Kg of N leached** – The loss or improvement to the overall business of implementation of a reduction in nutrient runoff. Expressed in relation to the kg of N reduced.

8. **Nitrogen Conversion Efficiency** This is a parameter reported in Overseer, in the N report, which shows the N in product divided by the total N inputs. This will be reduced if lower protein feeds are bought in to the system, and there is dilution of the total N cycling within the farm system. Normally, the higher the N conversion efficiency, the lower the overall leaching.

Risk

Measures of Risk assess the degree to which a business may move between profit and loss. These measures cannot be assessed as "better" or "worse" in one business compared to another. Highly productive farming systems may have a higher risk profile, but this is essential to attain higher levels of profit. However the higher risk profile does mean that they may be more exposed to changes in product prices or supplement prices or any potential constraints placed on their business.

1. **Operating Profit Margin** – (Operating Profit/ Gross Revenue x 100)
   This percentage measure of risk records the proportion of Gross Revenue that is retained as profit. This measure takes into account the changes in livestock, feed on hand, imputed labour and depreciation, therefore is a more complete measure than GFE/GFI %

2. **Total Operating Expenses as a % of Gross Revenue** (Total Operating Expenses / Gross Revenue x 100)
   This % measure of risk records the amount of gross revenue that goes towards the payment of operating expenses.

3. **Pasture as % of Total Consumed** (Energy Consumed from Pasture/Total Energy consumed by Livestock on Farm x 100).
   NZ pastoral systems can be regarded as lower risk if pasture makes up a large percentage of the diet – or above 70%.

Solvency

These measures assess the confidence with which a business can meet its obligations as they fall due. They give information about the appropriateness of the level of debt, the proportion of revenue being used to support the debt, and should be assessed in the light of all the other indicators as well.

1. **Equity %**- Equity / Total Assets x 100. This is a percentage measure of risk and solvency.

2. **Financing Costs as % of Gross Revenue**. (Interest + Bank Charges + Loan Fees + Lease Fees & Rentals / Gross Revenue x 100)

Liquidity

This gives a guide of the ability of the business to generate sufficient cash to meet its requirements.

Operating Profit less Debt Servicing – This will give an indication of what capital should be available after debt commitments have been met, after adjustments have been taken into account such as cost of plant replacement (depreciation), owners wage (imputed management), & change in values of stock and feed on hand.

Terms

DCD – 'dicyandiamide' – inhibits the first step in the nitrification process

Normalized- This refers to a year that has been adjusted to take out the variation due to drought, which in the year of 07-08 affected pasture intakes by the tune of 0.5-1.0 TDM of pasture per cow. The model is adjusted for the impact of abnormally high feed prices which occur in drought events, and abnormally high milk prices. Thus the year model is based on long term averaged feed prices, milk prices, and a typical year for pasture growth. The farm system is not optimized for optimum profit in this scenario, just adjusted for large variables that are exogenous to the system.

Optimized – This term refers to a farm system that has been manipulated to achieve the best possible return on capital, hence system

YIYO – This is a term used to define a year in year out scenario for a business. It assumes that long term average feed prices, and milk prices are used for dairy for example, and that the physical efficiencies of a farm are representative of a farms capability.